Issue June 1970

SOIL SURVEY

Safford Area, Arizona

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
UNIVERSITY OF ARIZONA AGRICULTURAL EXPERIMENT STATION

Major fieldwork for this soil survey was done in the period 1954–63. Soil names and descriptions were approved in 1966. Unless otherwise indicated, statements in this survey refer to conditions in the survey area in 1964. This survey was made cooperatively by the Soil Conservation Service and the University of Arizona Agricultural Experiment Station; it is part of the technical assistance furnished to the Gila Valley Soil Conservation District.

Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or can be purchased, on individual order, from the Cartographic Division, Soil Conservation Service, USDA, Washington, D.C. 20250.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY of the Safford Area, Ariz., contains information that can be applied in managing farms and ranches; in selecting sites for roads, ponds, buildings, or other structures; and in judging suitability of tracts of land for agriculture, industry, or recreation.

Locating Soils

All of the soils of the Safford Area are shown on the detailed map at the back of this survey. This map consists of many sheets that are made from aerial photographs. Each sheet is numbered to correspond with numbers shown on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbol. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information in the survey. This guide lists all of the soils of the survey area in alphabetic order by map symbol. It shows the page where each kind of soil is described, and also the page for the capability unit in which the soil has been placed.

Interpretations not included in the text can be developed by using the soil map and information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils in the soil descriptions and in the discussions of the capability units.

Engineers and builders will find under "Engineering Uses of Soils" tables that give engineering descriptions of the soils in the Safford Area and that name soil features that affect engineering practices and structures.

Scientists and others can read about how the soils were formed and how they are classified in the section "Formation and Classification of Soils."

Newcomers in the Safford Area may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the section "General Nature of the Area," which gives additional information about the county.

Cover picture: A typical view showing nearly level cropland of the inner valley near Safford. Mount Graham is in the background.

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UNITED STATES DEPARTMENT OF AGRICULTURE IN COOPERATION WITH UNIVERSITY OF ARIZONA AGRICULTURAL EXPERIMENT STATION

THE SAFFORD AREA is made up mainly of nearly level soils of the bottom lands and gently sloping soils of the terraces along the Gila River in the central part of Graham County (fig. 1). The survey area covers 208,500 acres, or about 325 square miles. Safford, the county seat of Graham County, began as the center of a small farming community and now has a population of more than 5,000. Thatcher is the second largest town and the site of Eastern Arizona Junior College. Other towns in the survey area are Pima, Solomon, and Fort Thomas.

Much of the bottom land along the river—36,000 to 40,000 acres—is in irrigated crops, mainly cotton, alfalfa, barley, and pasture. The gently sloping terraces that step up from one level to another to the foot of the mountains are grazed by cattle. Other parts of the survey area are used for range, wildlife, community developments, recreation, and watershed.

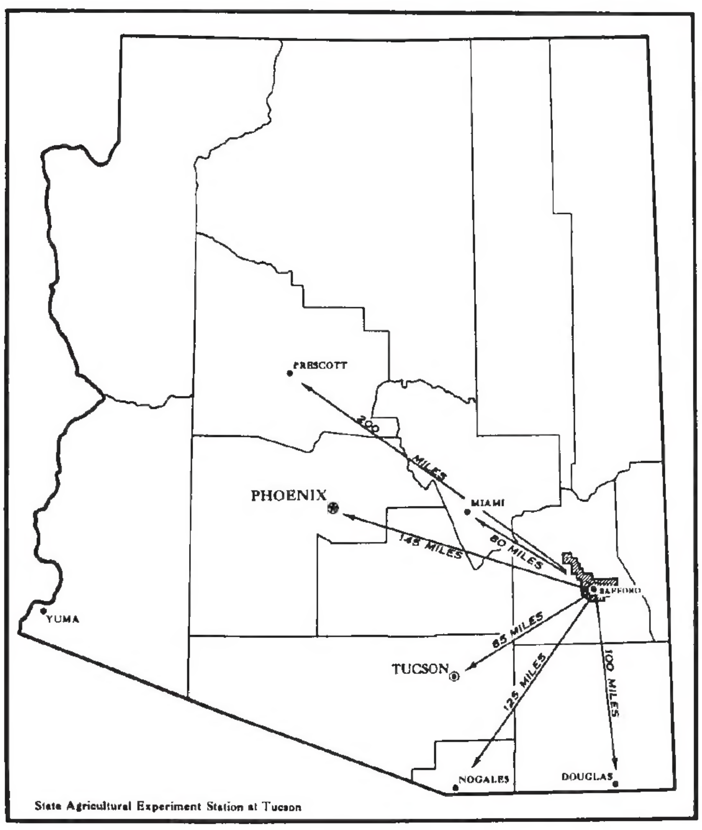

Figure 1.—Location of the Safford Area in Arizona.

Much of the water for irrigated crops is diverted from the Gila River, but some is pumped from wells. Between Stockton Wash and the Pinaleno Mountains south of Safford, water for irrigation is obtained from both artesian and pumped wells. Mountain streams provide water for some farms in spring or after rains in summer. The water supply for the town of Safford flows through pipes by gravity pressure from Bonita Creek, which is about 20 miles upstream and outside the survey area (*4*).[1] Under a cooperative watershed protection agreement between the Gila Valley Soil Conservation District and the towns of Safford and Thatcher, four large floodwater retarding structures now protect these towns and cropland south of the Gila River.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soils are in the Safford Area, where they are located, and how they can be used. The soil scientists went into the survey area knowing they likely would find many soils they had already seen and perhaps some they had not. As they traveled over the county, they observed steepness, length, and shape of slopes; size and speed of streams; kinds of native plants or crops; kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The soil series and the soil phase are the categories most used in a local survey.

[1] Italic numbers in parentheses refer to Literature Cited, page 56.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Gila and Glendale, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the natural landscape.

Soils of one series can differ somewhat in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Gila loam, 0 to 2 percent slopes, is one of several phases within the Gila series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodland, buildings, field borders, trees, and other details that greatly help in drawing soil boundaries accurately. The soil map in the back of this survey was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Two such kinds of mapping units are shown on the soil map of the Safford area: soil complexes and undifferentiated groups.

A soil complex consists of two or more soils so intermingled or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern of and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Bitter Spring-Pinaleno complex, 0 to 5 percent slopes, is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the survey, there is little value in separating them. The pattern and proportion of the soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. The name of the undifferentiated group consists of the names of the dominant soils, joined by "and." Anthony and Gila gravelly sandy loams, 0 to 2 percent slopes, is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, or so severely eroded that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types instead of soils and are given descriptive names. Rough broken land and Riverwash are examples of two land types in the Safford Area.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soils in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soils. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in a way that it is readily useful to different groups of readers, among them farmers, ranchers, engineers, and homeowners.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others, and then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in the Safford Area. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in an area, who want to compare different parts of an area, or who want to know the location of large tracts that are suitable for a certain kind of farming or other land use. Such a map is not suitable for planning the management of a farm or field, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect management.

The five soil associations in the Safford Area are described in the following pages.

1. Grabe-Gila-Anthony Association

Deep, nearly level, loamy soils of the inner valley

This association consists of soils on flood plains and alluvial fans along the Gila River and its tributaries of the inner valley. Slopes range from 0 to 2 percent. Elevations range from 2,600 to 3,100 feet above sea level, and the average annual rainfall is about 9 inches. In unirrigated areas the vegetation is mesquite, saltbush, saltcedar, creosotebush, and annual weeds and grasses. This association makes up about 43 percent of the Safford Area.

Grabe soils make up about 25 percent of this association; Gila soils, 23 percent; Anthony soils, 22 percent;

and minor soils, the remaining 30 percent. The minor soils of this association are the Pima, Glendale, Comoro, Arizo, Brazito, Guest, and Whitlock. Small areas of Riverwash also occur.

The Grabe and Gila are deep, are well drained, and have good available water holding capacity. The Grabe soils commonly have a dark-colored clay loam surface layer and loamy underlying material. The Gila soils commonly have a light-colored loam surface layer and loamy underlying material.

The Anthony soils are deep, are well drained, and have fair available moisture holding capacity. These soils commonly have a light-colored sandy loam surface layer and sandy loam underlying material.

The soils in this association are used mainly for irrigated crops. Cotton, alfalfa, small grains, and pasture grasses are the chief irrigated crops. Other irrigated crops are used for silage. Most of these soils have few limitations to use. To maintain good tilth and increase the intake of water, the manager should use green-manure crops and leave all crop residue on the soil. The coarser textured soils need irrigation more frequently than the finer textured soils.

Most of the soils in this association are well suited to community and industrial uses, but they require some management, depending on the characteristics of the soils. Most of the soil material is suitable for structural use in dams, dikes, and roadbeds.

2. Pinaleno-Bitter Spring-Tres Hermanos Association

Deep, nearly level to sloping, gravelly soils of the low terraces

This association consists of smooth, nearly level soils on low terraces and sloping soils on rounded ridges of the low terraces. These terraces are above the inner valley, and in a few places, large washes have cut into them.

This association extends from the eastern end of the survey area along both sides of the Gila River to the vicinity of Pima. Except for steep escarpments, slopes range from 0 to 5 percent. Elevations range from 2,700 to 3,200 feet above sea level, and the average annual rainfall is about 9 inches. Only a small acreage is irrigated. The vegetation is cresotebush, cholla, some mesquite, and annual grasses and weeds (fig. 2). This association makes up about 11 percent of the Safford Area.

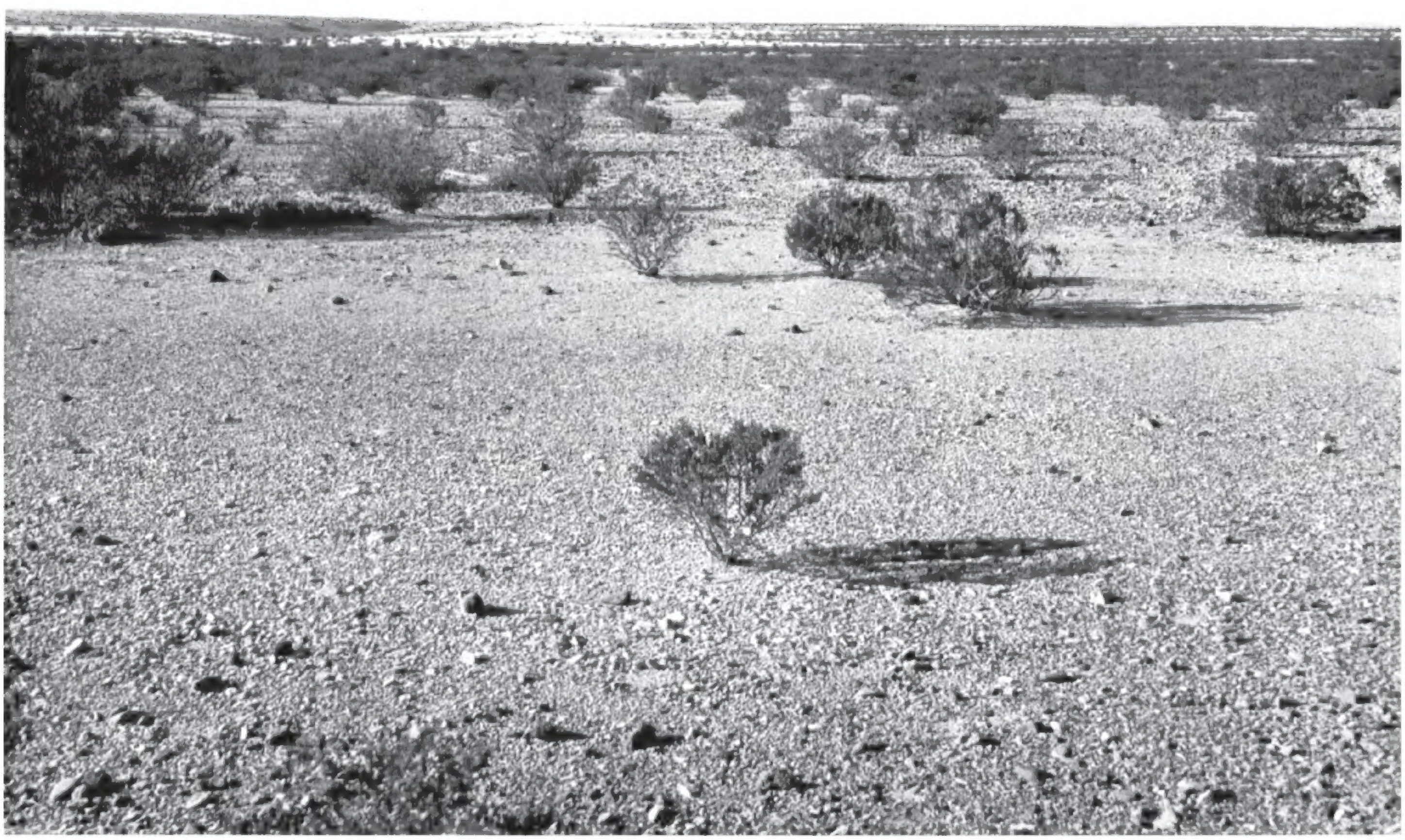

Figure 2.—**Typical vegetation on Pinaleno and Bitter Spring soils in association 2 A good stand of annual grasses occurs during part of the year. The shrubs are creosotebush of no forage value.**

The Pinaleno soils make up about 50 percent of this association; Bitter Spring soils, 20 percent; Tres Hermanos soils, 15 percent; and minor soils and land types, 15 percent. The minor soils in this association are the Cave, Continental, Anthony, Gila, Arizo, and Whitlock and areas of Riverwash and Rough broken land.

The Pinaleno soils are on the top and edges of low terraces and are deep and well drained. They typically have a brown gravelly loam surface layer and a reddish-brown very gravelly loam or clay loam subsoil. At a depth of 2 to 3 feet is a layer of weakly cemented accumulated lime. The available moisture holding capacity is low to fair.

The Bitter Spring soils are on the less sloping parts of low terraces. They are deep, well drained, and calcareous. They typically have a thin, brown gravelly sandy loam surface layer and a gravelly loam or sandy loam subsoil. The available moisture holding capacity is low to fair.

The Tres Hermanos soils occupy the tops of terraces and side slopes on low knolls. They are deep, well drained, and calcareous. They typically have a pink gravelly sandy loam surface layer and a brown sandy clay loam subsoil. The available moisture holding capacity is fair. In some places Tres Hermanos soils are saline and have little or no vegetation.

The soils in this association are used mainly for desert range. Cattle and wildlife graze the sparse vegetation, but in only a few places can the animals obtain drinking water. Most of the grazing is provided by annuals that grow early in spring and during rainy periods in summer.

The soils in this association are suitable as sites for community and industrial buildings, and some houses have been built on the terraces north of Safford. The Pinaleno soils are an important source of road fill. On this association some of the water from rainfall runs into sandy washes and recharges the ground water.

3. Continental-Gila-Rough Broken Land Association

Deep, nearly level to gently sloping, gravelly and loamy soils of the low and middle terraces and areas of Rough broken land

This association consists of soils on broad terraces and alluvial fans along the south side of the inner valley from Stockton Wash to the northwestern boundary of the Safford Area. Low ridges are on the terraces, and washes have cut deep canyons that have steep side slopes. Slopes range from 0 to 60 percent. Elevations range from 2,700 to 3,300 feet, and the average annual rainfall is about 9 inches. The vegetation is creosotebush, snakeweed, saltbush, mesquite, cactus, ocotillo, some tobosa, and annual weeds and grasses (fig. 3). This association makes up about 15 percent of the Safford Area.

Continental soils make up about 35 percent of this association; Gila soils, 25 percent; Rough broken land, 20 percent; and minor soils and land types, 20 percent. The minor soils of this association are the Anthony, Pinaleno, Cave, and Arizo. Gravelly alluvial land also occurs in a small acreage.

The Continental soils are on the tops of the terraces and generally are about 29 inches deep over a weakly to strongly cemented layer of accumulated lime. They commonly have a reddish-brown gravelly sandy loam surface layer and a gravelly clay loam or cobbly clay subsoil above the cemented layer. The available moisture holding capacity is low.

The Gila soils are on the flood plains of washes and on the low ridges of the terraces. These soils are deep, are well drained, and commonly have a gravelly sandy loam surface layer and brown, loamy underlying material. The available moisture holding capacity is good.

Rough broken land consists of exposed valley fill on the steep, eroded sides of terraces and canyons. This valley fill ranges from gravelly sand to clay, but in many places it is silty. In some places gravel is exposed, and many areas are saline. The available moisture holding capacity ranges from very low to good, depending on texture.

The soils in this association are used for grazing, wildlife, and water supply. None of the acreage is irrigated. Because annual rainfall is low, these soils provide little forage for cattle or wildlife except early in spring and late in summer when annual plants grow after rains. Rabbits, quail, and doves live near the washes, but the number of wildlife depends on the amount of suitable food available in the association.

These soils are suited to community and industrial buildings and for most earthen structures of the kinds needed in engineering. Some of the water from rainfall runs into the sandy washes and recharges the ground water.

4. Continental-Pinaleno-Cave Association

Nearly level to steep, gravelly soils of the high terraces that are shallow to deep over accumulated lime

This association consists of nearly level to steep soils on high terraces. Slopes range mostly from 0 to 5 percent, but in some places they are more than 30 percent. The terraces are dissected and drained by washes that flow into the Gila River. These washes have cut deep canyons that have steep side slopes. Elevations range from 2,800 to 4,800 feet, and the average annual rainfall from 9 to 11 inches. The vegetation is mostly creosotebush, whitethorn, catclaw, and mesquite, but annual grasses and weeds grow after rainy periods. On the higher parts of the terraces are areas in curly mesquite, tobosa, snakeweed, wolfberry, and many annual plants but only a small amount of creosotebush. This association makes up about 29 percent of the Safford Area.

Continental soils make up about 30 percent of this association; Pinaleno soils, 25 percent; Cave soils, 18 percent; and minor soils and land types, 27 percent. The minor soils of this association are the Anthony, Gila, Arizo, and Cellar. Gravelly alluvial land, Rock land, and Rough broken land also occur in small areas.

The Continental soils are on the tops of the terraces. These soils are deep, well drained, and reddish brown. They commonly have a gravelly sandy loam surface layer and a gravelly clay loam or cobbly clay subsoil. A strongly cemented layer of lime generally is below a

***Figure 3.*—View in soil association 3. In the foreground are Continental soils covered with creosotebush. In the background are Rough broken land and the snow-sprinkled Pinaleno Mountains.**

depth of 20 inches, but at the higher elevations it is below a depth of 3 feet. The available moisture holding capacity is fair.

The Pinaleno soils are on the lower edges and alluvial fans of the terraces. These soils are deep, well drained, and reddish brown. They commonly have a gravelly loam surface layer and a very gravelly loam or clay loam subsoil. A cemented layer of accumulated lime is below a depth of 3 feet. The available moisture holding capacity is low to fair.

The Cave soils are on the rounded ridges and edges of terraces and on remnants of dissected terraces. These soils are well drained and light brown to pinkish gray. They have a gravelly sandy loam surface layer and gravelly loam underlying material. These soils are less than 20 inches deep over a strongly cemented layer of lime and are calcareous throughout. The available moisture holding capacity above the cemented layer is very low.

The soils of this association are used for grazing, wildlife, and water supply. Grazing is fair on areas of Continental and Pinaleno soils that have little brush. It is better near the mountains than near the river. Drinking water is available for cattle most of the year. Deer, rabbits, and small game birds generally live near the drainageways.

These soils are suited to community and industrial buildings and for most earthen structures of the kinds used in engineering. The Cave soils and Gravelly alluvial land are useful as material for building roads. Some of the water from rainfall and melting snow on this association runs into drainageways and recharges the ground water.

5. Graham Association

Shallow, gently sloping to steep, rocky soils of the uplands

This association consists of gently sloping to steep soils on long, narrow, rounded ridgetops and the sides of deep canyons on the eastern part of the Gila Mountains. Slopes range from 2 to 40 percent. Elevations range from 3,600 to 4,500 feet, and the average annual rainfall is about 11 inches. The vegetation is mainly tobosa, side-oats grama, three-awn, paloverde, ocotillo, snakeweed, and cactus, but Mormon tea, haujillo, and a few junipers grow on north-facing slopes. This association makes up about 2 percent of the Safford Area.

Graham soils make up about 60 percent of this association. The remaining 40 percent consists of bare rock, very shallow soils on steep mountaintops and side slopes, and areas of talus.

The Graham soils are mainly on the sides and tops of mountains. These soils are shallow, well drained, and dark reddish brown. They commonly have a very cobbly clay loam surface layer and a gravelly clay loam or clay subsoil. Graham soils formed from weathered basalt and are 12 to 20 inches deep to bedrock. The available moisture holding capacity above the bedrock is very low. Rock crops out along the narrow ridgetops and on steep side slopes.

The soils in this association are used for desert range, wildlife, and water supply. The grasses provide good grazing for cattle, and drinking water is available most of the year in ponds built on the bottom of canyons. This mountainous association provides food and protection for many kinds of wildlife. Much of the runoff from precipitation flows into sandy drainageways and recharges the ground water.

Descriptions of the Soils

In this section the soil series and the mapping units in the series are described. The acreage and proportionate extent of each mapping unit are given in table 1.

The procedure in this section is first to describe the soil series and then the mapping units in that series. Thus to get full information on any one mapping unit, it is necessary to read the description of that unit and also the description of the soil series to which it belongs. The description of a soil series mentions features that apply to all the soils in the series. Differences among the soils of one series are pointed out in the description of the individual soils or are indicated in the soil name. Unless otherwise stated, the description of each mapping unit in this section is for a dry soil. As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Rough broken land and Riverwash, for example, are miscellaneous land types and do not belong to a soil series; nevertheless, they are listed in alphabetic order along with the series.

Following the name of each mapping unit, there is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit are the dryland capability unit and the irrigated capability unit in which the mapping unit has been placed. The pages on which each capability unit is described can be found by referring to the "Guide to Mapping Units" at the back of this survey.

Soil scientists, engineers, students, and others interested in more information about soil series should turn to the section "Formation and Classification of Soils." Many terms used in the soil descriptions are defined in the Glossary at the back of this soil survey.

Agua Series

The Agua series consists of well-drained, nearly level soils that commonly have a clay loam or loam surface layer over loam that extends to a depth of about 2 feet. Below this depth is sand and gravel. These soils formed in mixed alluvium deposited on flood plains and fans by streams and washes. Elevation ranges from 2,600 to 3,000 feet, and the average annual rainfall is about 9 inches. In areas not cultivated the vegetation is creosotebush, mesquite, saltbush, and annual weeds and grasses.

The surface layer ranges from 6 to 14 inches in thickness and from brown clay loam to light brownish-gray loam in texture. Below this layer is pale-brown loam, silt loam, or very fine sandy loam that generally is stratified and that overlies light yellowish-brown gravelly sand or sand. These soils generally are calcareous throughout the profile.

The Agua soils occur with the Gila, Maricopa, and Grabe soils.

Agua soils are used for irrigated crops, desert range, and water supply. The irrigated crops generally grown are sorghum, alfalfa, cotton, small grains, and pasture plants.

Agua loam (Ag).—This soil occurs on flood plains and alluvial fans of the inner valley. The surface is smooth. Slopes range from 0 to 2 percent but generally are less than 1 percent.

Representative profile (1,150 feet north and 1,450 feet west of the southeast corner of section 16, T. 6 S., R. 25 E.):

Ap—0 to 12 inches, light brownish-gray (10YR 6/2) and brown (10YR 5/3) loam, dark brown (10YR 3/3) and (7.5YR 4/4) when moist; massive; hard, friable, slightly sticky and slightly plastic; abundant very fine and fine roots; common, very fine and fine, tubular and few, very fine and fine, interstitial pores; 2 to 4 percent of volume is gravel; slightly effervescent; moderately alkaline (pH 8.2); clear, smooth boundary.

C1—12 to 27 inches, pale-brown (10YR 6/3) loam, dark brown (7.5YR 4/4) when moist; massive; hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; few, very fine and fine, tubular and interstitial pores; 5 to 10 percent of volume is gravel; strongly effervescent; moderately alkaline (pH 8.2); clear, smooth boundary.

IIC2—27 to 45 inches, light yellowish-brown (10YR 6/4) and varicolored stratified sand and very gravelly sand, yellowish brown (10YR 5/4) when moist; single grain; loose when moist or dry, nonsticky and nonplastic; few very fine roots; common, fine and medium, interstitial pores; 35 to 55 percent of volume is gravel; slightly effervescent; moderately alkaline (pH 8.0).

The hues of the A and C horizons range from 7.5YR to 10YR. When dry, the A horizon ranges from 5 to 7 in value.

TABLE 1.—*Approximate acreage and proportionate extent of soils*

Mapping unit	Area	Extent
	Acres	*Percent*
Agua clay loam	390	0. 2
Agua loam	2, 300	1. 1
Anthony clay loam, 0 to 2 percent slopes	1, 630	. 8
Anthony-Continental-Pinaleno gravelly sandy loams, 0 to 5 percent slopes	2, 840	1. 4
Anthony and Gila gravelly sandy loams, 0 to 2 percent slopes	17, 820	8. 6
Anthony gravelly sandy loam, 0 to 5 percent slopes	2, 880	1. 4
Anthony loam, 0 to 2 percent slopes	2, 700	1. 3
Anthony sandy loam, 0 to 2 percent slopes	2, 620	1. 3
Arizo sandy loam, 0 to 2 percent slopes	480	. 2
Arizo gravelly sandy loam, 0 to 2 percent slopes	1, 070	. 5
Arizo gravelly sandy loam, 2 to 5 percent slopes	3, 910	1. 9
Arizo loam, 0 to 2 percent slopes	550	. 3
Arizo gravelly loam, 0 to 2 percent slopes	1, 120	. 5
Bitter Spring gravelly sandy loam, 2 to 5 percent slopes	3, 410	1. 6
Bitter Spring-Pinaleno complex, 0 to 5 percent slopes	3, 090	1. 5
Brazito loam	660	. 3
Brazito sandy loam	880	. 4
Cave gravelly sandy loam, 0 to 5 percent slopes	1, 470	. 7
Cave gravelly sandy loam, 5 to 30 percent slopes	3, 170	1. 5
Cave-Pinaleno complex, 0 to 20 percent slopes	5, 620	2. 7
Cellar soils, 2 to 50 percent slopes	980	. 5
Comoro loam	2, 430	1. 2
Comoro loam, mottled variant	490	. 2
Comoro sandy loam	470	. 2
Continental cobbly sandy loam, 2 to 5 percent slopes	430	. 2
Continental-Gila gravelly sandy loams, 0 to 5 percent slopes	8, 710	4. 2
Continental-Pinaleno complex, 0 to 5 percent slopes	10, 670	5. 1
Gila loam, 0 to 2 percent slopes	10, 050	4. 8
Gila loam, saline, 0 to 2 percent slopes	580	. 3
Gila loam, 2 to 5 percent slopes	290	. 1
Gila gravelly loam, 0 to 2 percent slopes	500	. 2
Gila sandy loam, 0 to 2 percent slopes	1, 700	. 8
Gila and Glendale soils, 0 to 2 percent slopes	10, 610	5. 1
Glendale silt loam, saline	1, 200	0. 6
Glendale silt loam, saline-alkali	1, 010	. 5
Glendale silty clay loam, saline	720	. 4
Glendale loam	2, 080	1. 0
Grabe clay loam	12, 420	6. 0
Grabe loam	6, 000	2. 9
Grabe loam, saline	280	. 1
Graham extremely rocky clay loam, 2 to 40 percent slopes	3, 760	1. 8
Gravelly alluvial land	8, 150	3. 9
Guest clay	2, 240	1. 1
Maricopa loam	1, 010	. 5
Maricopa sandy loam	360	. 2
Pima clay loam	4, 650	2. 2
Pima clay	2, 290	1. 1
Pima clay loam, saline	800	. 4
Pima loam	490	. 2
Pinaleno gravelly loam, 0 to 5 percent slopes	4, 670	2. 2
Pinaleno-Bitter Spring complex, 0 to 5 percent slopes	4, 390	2. 1
Pinaleno-Cave complex, 0 to 5 percent slopes	4, 270	2. 1
Pinaleno cobbly loam, 2 to 5 percent slopes	2, 750	1. 3
Pinaleno-Continental gravelly sandy loams, 0 to 10 percent slopes	13, 190	6. 3
Riverwash	1, 330	. 6
Rock land	1, 120	. 5
Rough broken land	13, 340	6. 4
Tidwell sandy loam, 0 to 2 percent slopes	940	. 5
Tidwell extremely rocky sandy loam, 0 to 5 percent slopes	490	. 2
Tidwell, Gila and Glendale soils, saline, 0 to 2 percent slopes	1, 140	. 5
Tres Hermanos-Bitter Spring gravelly sandy loams, 0 to 10 percent slopes	3, 460	1. 7
Whitlock loam, 0 to 2 percent slopes	430	. 2
Whitlock sandy loam, 0 to 2 percent slopes	510	. 2
Whitlock sandy loam, 2 to 5 percent slopes	240	. 1
Water	2, 050	1. 0
Gravel pits	200	. 1
Total	208, 500	100. 0

When moist, this horizon ranges from 3 to 5 in value and from 3 to 4 in chroma. The C1 horizon ranges from 4 to 6 in value when dry, and from 3 to 4 when moist. In most places the texture of the A horizon is loam, but in some places it ranges from silt loam to very fine sandy loam. In places the C1 horizon is uniformly loam or very sandy loam, but it frequently contains thin layers ranging from silt loam to sandy loam. The IIC2 horizon ranges from fine sand to very gravelly sand in texture. Depth to the IIC2 horizon ranges from 20 to 36 inches but commonly is about 24 to 27 inches.

Permeability of this soil is moderate to a depth of about 2 feet and very rapid below this depth. Runoff is slow. The available moisture holding capacity is fair. The organic-matter content is low, and fertility is medium to high. In most places roots penetrate to a depth of about 24 to 36 inches, but the roots of alfalfa and other deep-rooted crops penetrate to 60 inches or more.

Where this soil is irrigated, the chief crops grown are barley, sorghum, cotton, and alfalfa. This soil is suited to shallow-rooted crops and to alfalfa, but it is not well suited to cotton. Unirrigated areas are used for desert range and water supply. Capability unit IIs–5 (irrigated), VIIs–1 (dryland).

Agua clay loam (Ac).—This soil is near Agua loam and, except for having a finer textured surface layer, is similar to that soil. Slopes generally are less than 0.5 percent, but they range from 0 to 2 percent. The surface layer ranges from 10 to 14 inches in thickness.

Included with this soil in mapping were areas that have a loam or silty clay loam surface layer.

This soil is used for irrigated barley, sorghum, cotton, and alfalfa. It is suited to barley, grass, and other shallow-rooted crops and to alfalfa. It is not well suited to cotton. Capability unit IIs–5 (irrigated).

Anthony Series

The Anthony series consists of well-drained, nearly level or gently sloping soils that have a clay loam, loam, sandy loam, or gravelly sandy loam surface layer. In many places the underlying material is stratified. Elevations range from 2,600 to 3,300 feet, and the average annual rainfall is about 9 inches. In areas not cultivated the vegetation is mainly creosotebush, mesquite, saltbush, and annual grasses and weeds.

The surface layer ranges from pale-brown clay loam to brown gravelly sandy loam in texture and from 2 to 14 inches in thickness. Below this layer is light yellowish-brown to dark-brown fine sandy loam to very gravelly sandy loam that is stratified with silt loam or loamy sand in some places. These soils are neutral to moderately alkaline and in most places are calcareous throughout the profile. In places sand and gravel are below a depth of 3 feet.

Anthony soils are used for all adapted irrigated crops, for grazing cattle, for wildlife, and for water supply. These soils are suited to cotton, alfalfa, barley, sorghum, pasture grasses, and all other crops commonly grown. In the inner valley, they are important for growing cultivated crops.

Anthony sandy loam, 0 to 2 percent slopes (AnA).—This soil occurs in the inner valley. The surface is smooth to slightly undulating, and the slopes generally are less than 1 percent.

Representative profile (900 feet north and 1,600 feet west of the southeast corner of section 2, T. 7 S., R. 27 E.):

A1—0 to 2 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) when moist; weak, medium, platy structure; soft, very friable, nonsticky and nonplastic; few very fine roots; few fine interstitial pores; slightly effervescent; moderately alkaline (pH 8.0); abrupt, smooth boundary.

C1—2 to 30 inches, pale-brown (10YR 6/3) fine sandy loam, dark brown (10YR 4/3) when moist; massive; soft, very friable, nonsticky and slightly plastic; few fine and medium and plentiful very fine roots; few very fine tubular pores; strongly effervescent; moderately alkaline (pH 8.0); gradual, wavy boundary.

IIC2—30 to 46 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) when moist; few to common fine pebbles; massive; soft, friable, nonsticky and slightly plastic; few very fine roots; few very fine tubular pores; strongly effervescent; moderately alkaline (pH 8.0); clear, wavy boundary.

IIIC3—46 to 60 inches, brown (10YR 5/3) very gravelly sandy loam, dark brown (10YR 4/3) when moist; massive; soft, friable, nonsticky and slightly plastic; few very fine roots; few very fine tubular pores; strongly or violently effervescent; moderately alkaline (pH 8.0); 50 percent of the volume is gravel, and 20 percent, cobblestones.

The A1 horizon generally is light colored, but in places it is dark colored to a depth of as much as 6 inches. Hues range from 7.5YR to 10YR. Values are 5 or greater when the soil is dry and are greater than 3.5 when the soil is moist. The A1 horizon ranges from sandy loam to loamy very fine sand. In the A1, C1, and C2 horizons, texture ranges from fine sandy loam to loamy very fine sand, and there are thin strata ranging from silt loam to loamy sand.

Included with this soil in mapping were small areas of Gila, Comoro, and Brazito soils.

Permeability of this soil is moderately rapid below a depth of about 12 inches, and runoff is slow to medium. The available moisture holding capacity is fair. Roots can penetrate to a depth of more than 60 inches. The organic-matter content and natural fertility are low. If some plant cover is maintained, the hazard of soil blowing or water erosion is slight.

Where this soil is irrigated, cotton, corn, small grains, sorghum, and grasses are grown. Legumes and grasses are better suited than row crops. Unirrigated areas are used for desert range, wildlife, and water supply. Capability unit IIs-6 (irrigated), VIIs-1 (dryland).

Anthony clay loam, 0 to 2 percent slopes (AhA).—This soil is on flood plains and alluvial fans of streams and washes in the inner valley. Except for having a finer textured surface layer, this soil is similar to Anthony sandy loam, 0 to 2 percent slopes. The surface layer ranges from 10 to 14 inches in thickness. Natural fertility is medium. This soil has a smooth surface, and slopes generally are less than 0.5 percent. Runoff is very slow.

Included with this soil in mapping were small areas of Gila, Comoro, and Brazito soils.

This soil is used only for irrigated crops. Cotton, barley, alfalfa, sorghum, and all other crops suited to the survey area are grown. Capability unit IIs-3 (irrigated).

Anthony gravelly sandy loam, 0 to 5 percent slopes (AlB).—This soil occurs on alluvial fans and terraces above the inner valley and on flood plains of tributaries of the Gila River. The surface layer is mainly gravelly sandy loam but is sandy loam in places.

Except that 10 to 30 percent of the surface layer is gravel and slopes are as much as 5 percent, this soil is similar to Anthony sandy loam, 0 to 2 percent slopes. The surface layer ranges from 4 to 10 inches in thickness. The available moisture holding capacity is low. This soil is neutral to moderately alkaline and in some places is slightly calcareous. The surface is smooth to undulating.

Included with this soil in mapping were small areas of Gila, Brazito, and Arizo soils. Also included were small areas that have slopes of more than 5 percent and some that are gravelly below a depth of 2 feet.

This soil is used only for desert range, wildlife, and water supply. Few forage plants grow, but annual grasses, weeds, mesquite, and saltbush provide seasonal grazing. Because rainfall is low and water is not available for irrigation, this soil is not suited to cultivated crops. Capability unit VIIs-1 (dryland).

Anthony loam, 0 to 2 percent slopes (AmA).—Except for having a finer textured surface layer, this soil is similar to Anthony sandy loam, 0 to 2 percent slopes. This soil is on flood plains and alluvial fans along streams and washes of the inner valley. The surface is smooth, and slopes generally are less than 1 percent.

Where this soil is irrigated, it is suited to and used for cotton, alfalfa, barley, and all adapted cultivated crops. Unirrigated areas are used for desert range, wildlife, and water supply. Capability unit IIs-3 (irrigated), VIIs-1 (dryland).

Anthony-Continental-Pinaleno gravelly sandy loams, 0 to 5 percent slopes (ApB).—About 45 to 50 percent of this complex is Anthony soil; 20 to 35 percent, Continental soil; 15 to 20 percent, Pinaleno soil; and 5 to 20 percent, included soils. The Anthony soil is similar to Anthony gravelly sandy loam, 0 to 5 percent slopes. A representative profile for a Continental and a Pinaleno soil is described under the respective series. Erosion of this complex is slight to moderate.

The Anthony soil in this complex is in drainageways and on the side slopes of terraces above the inner valley. The Continental soil is on the tops of the terraces, and in most places slopes are less than 2 percent. The Pinaleno

soil is on the edges and side slopes of the terraces and generally has slopes of less than 2 percent. Included with this complex in mapping were areas of Bitter Spring and Gila soils and of Rough broken land.

The soils of this complex are used only for desert range, wildlife, and water supply. The natural vegetation provides some grazing. It consists mainly of creosotebush, cholla, ocotillo, and annual grasses and weeds, but some saltbush and yucca grow in eroded areas. Capability unit VIIs-1 (dryland).

Anthony and Gila gravelly sandy loams, 0 to 2 percent slopes (AtA).—This undifferentiated group of soils is on flood plains of streams and washes of the inner valley. The Anthony soil is similar to Anthony gravelly sandy loam, 0 to 5 percent slopes, and the Gila soil is similar to Gila gravelly sandy loam, 0 to 2 percent slopes. Each of these soils makes up about half of this mapping unit. Drainageways are choked with sand and gravel, but the large washes are entrenched in the flood plain.

These soils are used for desert range, wildlife, and water supply. The natural vegetation provides some grazing. It consists of mesquite, creosotebush, catclaw, whitethorn, yucca, cactus, and annual grasses and weeds. Capability unit VIIs-1 (dryland).

Arizo Series

The Arizo series consists of deep, nearly level to gently sloping, excessively drained soils that have a loam, gravelly loam, sandy loam, or gravelly sandy loam surface layer. Elevations range from 2,600 to 3,000 feet, and the average annual rainfall is about 9 inches. In areas not irrigated, the vegetation is mainly a sparse stand of mesquite, whitethorn, catclaw, or creosotebush, and annual grasses and weeds.

The surface layer ranges from brownish gray to dark brown in color, from loam to gravelly sandy loam in texture, and from 7 to 14 inches in thickness. Below this layer is brown to light brownish-gray, stratified loam to very gravelly and cobbly sand. These soils are moderately alkaline and range from slightly calcareous to strongly calcareous.

Arizo soils occur in small areas. Where they are in cultivated fields, these soils are used for irrigated crops. Under irrigation, alfalfa and pasture grasses grow well, but the growth of cotton, barley, and sorghum is poor. Unirrigated areas are used for grazing cattle and for wildlife.

Arizo sandy loam, 0 to 2 percent slopes (AuA).—Small areas of this soil occur on flood plains and alluvial fans of the inner valley. This soil has a smooth surface and is near the Anthony, Comoro, and Brazito soils.

Representative profile (in the northern half of NE¼SE¼ section 27, T. 6 S., R. 25 E.):

A1—0 to 8 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) when moist; weak, thick, platy strucure that appears to result from stratification; slightly hard, friable, nonsticky and slightly plastic; slightly effervescent; moderately alkaline (pH 8.0); clear, smooth boundary.

C -8 to 40 inches, light brownish-gray (10YR 6/2) and brown (10YR 5/3) stratified very gravelly and cobbly sand and gravelly sandy loam, dark brown (10YR 4/3) when moist; single grain; loose when moist or dry, nonsticky and nonplastic; slightly effervescent; moderately alkaline (pH 8.0).

Hues of the A and C horizons range from 7.5YR to 10YR. Values of the A horizon when dry are 5 or 6, and 3 or 4 when wet. The content of organic matter is less than 1 percent. The A horizon is mainly sandy loam, but it ranges from loam to loamy sand. The C horizon is stratified, and the layers range from gravelly loam to very gravelly or cobbly sand in texture.

Permeability below the surface layer and infiltration are very rapid, and runoff is slow. The available moisture holding capacity is very low. Roots can penetrate below a depth of 60 inches. Organic-matter content and natural fertility are very low.

This soil is used for irrigated alfalfa and pasture, but most other crops are not grown. Unirrigated areas provide little grazing for cattle, because the natural vegetation consists of mesquite, tamerisk, and willow. This soil is suited to irrigated pasture and wildlife. It can be used as structural material. Capability unit IVs-1 (irrigated), VIIs-3 (dryland).

Arizo gravelly sandy loam, 0 to 2 percent slopes (AvA).—This soil occurs on river flood plains and alluvial fans around the edges of the inner valley and on terraces. Except for having gravel in the surface layer, this soil is similar to Arizo sandy loam, 0 to 2 percent slopes.

This soil is used for irrigated alfalfa and pasture, but most other crops are not grown. Unirrigated areas are used for desert range and wildlife. Capability unit IVs-1 (irrigated), VIIs-3 (dryland).

Arizo gravelly sandy loam, 2 to 5 percent slopes (AvB).—Except for having gravel in the surface layer and gentle slopes, this soil is similar to Arizo sandy loam, 0 to 2 percent slopes. This soil is on alluvial fans of terraces and along washes below terrace breaks. Included with this soil in mapping were small areas that have a gravelly loam surface layer.

Because water is not available for irrigation, this soil is not used for crops. It is used for desert range, wildlife, and water supply. The vegetation is mainly creosotebush, mesquite, annual weeds and grasses, and some cactus, and it provides little grazing. Capability unit VIIs-3 (dryland).

Arizo loam, 0 to 2 percent slopes (AwA).—Except that the surface layer is loam to a depth of 10 to 14 inches, this soil is similar to Arizo sandy loam, 0 to 2 percent slopes. The available moisture holding capacity is low. Included with this soil were some small, nearly level areas that have a clay loam surface layer.

Where this soil is irrigated, pasture plants, barley, and alfalfa are well suited. This soil is also used for wildlife and water supply. Capability unit IIIs-2 (irrigated), VIIs-3 (dryland).

Arizo gravelly loam, 0 to 2 percent slopes (AzA).—Except for having a texture of gravelly loam in the surface layer, this soil is similar to Arizo sandy loam, 0 to 2 percent slopes. Enough gravel is in the surface layer to interfere with tillage, but some of the larger pebbles can be removed.

This soil is suited to irrigated alfalfa and pasture, but most other crops are not grown. Unirrigated areas are suited to wildlife and desert range. Capability unit IVs-1 (irrigated), VIIs-3 (dryland).

Bitter Spring Series

The Bitter Spring series consists of deep, well-drained, nearly level to gently sloping soils that have a gravelly loam or gravelly sandy loam surface layer. These soils formed in old alluvial material. This weathered from rocks that contain calcium carbonate, and the soils are calcareous. Elevations range from 2,700 to 3,200 feet, and the average annual rainfall is about 9 inches. The vegetation is mainly creosotebush, cholla, and a few annual weeds and grasses.

The surface layer is light-brown gravelly loam or gravelly sandy loam about 2 to 7 inches thick. This layer has platy structure in the upper 2 inches. The slightly hard subsoil is light-brown to light reddish-brown gravelly sandy loam or gravelly loam that ranges from 8 to 16 inches in thickness. Underlying the subsoil is brown to pink gravelly loam and gravelly sandy loam that is strongly calcareous.

Because water is not available for irrigation on the Bitter Spring soils, irrigated crops are not grown. The soils are used for desert range, wildlife, recreation, and water supply.

Bitter Spring gravelly sandy loam, 2 to 5 percent slopes (BeB).—This soil is on ridges of the lower terraces above the inner valley. The surface is a smooth to undulating erosion pavement that is covered by desert varnish.

Representative profile (1,250 feet west and 2,100 feet north of the southeast corner of section 1, T. 7 S., R. 27 E., on a low hill):

A11—0 to 2 inches, light-brown (7.5YR 6/4) gravelly sandy loam, brown (7.5YR 5/4) when moist; weak, medium and thick, platy structure; slightly hard, very friable, nonsticky and slightly plastic; few fine and medium roots; common, fine, vesicular and few, very fine, interstitial pores; slightly effervescent; moderately alkaline (pH 8.0); abrupt, wavy boundary.

A12—2 to 6 inches, light-brown (7.5YR 6/4) gravelly sandy loam, dark brown (7.5YR 4/4) when moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine and medium roots; common, fine, vesicular and few, very fine, interstitial pores; strongly effervescent; moderately alkaline (pH 8.0); clear, smooth boundary.

B2t—6 to 20 inches, light-brown (7.5YR 6/4) gravelly loam, brown (7.5YR 5/4) when moist; few, fine and medium, pink (7.5YR 8/4) nodules of lime; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; few, fine, tubular pores; strongly or violently effervescent; moderately alkaline (pH 8.0); clear, wavy boundary.

C1ca—20 to 30 inches, pink (7.5YR 8/4) gravelly loam, brown (7.5YR 5/4) when moist; massive; soft, friable, slightly sticky and slightly plastic; few very fine roots; few, very fine, tubular pores; violently effervescent; moderately alkaline (pH 8.0); gradual, wavy boundary.

C2ca—30 to 52 inches, light-brown (7.5YR 6/4) gravelly loam, brown (7.5YR 5/4) when moist; massive; soft, friable, slightly sticky and slightly plastic; few, fine, tubular pores; violently effervescent; moderately alkaline (pH 8.0).

Hues of the A and B horizons range from 5YR to 7.5YR. Values of the A horizon when dry or moist range from 4 to 7 and chromas from 2 to 4. The texture of the A horizon ranges from gravelly sandy loam to gravelly loam. In many areas the exposed gravel is coated with desert varnish. In many places the B horizon abruptly underlies the thin erosion pavement. The content of lime in the B horizon increases with depth and forms mycelialike veins in the lower part.

Included with this soil were small areas of soils that are noncalcareous clay loam to a depth of 12 to 18 inches, of soils that are sandy loam to a depth of 5 feet or more, and of soils that are steep and gravelly.

Permeability is moderate, and runoff is rapid to medium. Because the stand of vegetation is sparse and the content of organic matter is low, the surface of this soil seals readily and retards infiltration. The available moisture holding capacity is low. Roots penetrate to a depth of 24 to 36 inches. The hazard of water erosion or soil blowing is slight.

Water for irrigation is not available, and this soil is not used for irrigated crops. It is suited only to desert range, wildlife, recreation, and water supply. Capability unit VIIs–7 (dryland).

Bitter Spring-Pinaleno complex, 0 to 5 percent slopes (BpB).—About 50 to 55 percent of this complex is Bitter Spring soil; 40 to 45 percent, Pinaleno soil; and 5 to 10 percent, included soils. The Bitter Spring soil is similar to Bitter Spring gravelly sandy loam, 2 to 5 percent slopes. A representative profile for a Pinaleno soil is described under the Pinaleno series.

The Bitter Spring soil in this complex is on the lower terraces above the inner valley. The Pinaleno soil is mainly on ridges of the lower terraces. Included with this complex were areas of Tres Hermanos soils and areas of Gravelly alluvial land and of Rough broken land.

The soils of this complex are used for desert range, wildlife, and water supply. The natural vegetation provides some grazing. It consists mainly of creosotebush, cholla, and some annual grasses and weeds. Capability unit VIIs–7 (dryland).

Brazito Series

The Brazito series consists of deep, excessively drained, nearly level soils that have a loam or sandy loam surface layer. The underlying material is sand. These soils formed in mixed sediment deposited on flood plains and alluvial fans. Elevations range from 2,600 to 3,200 feet, and the average annual rainfall is about 9 inches. In areas not cultivated the vegetation is mainly creosotebush and annual grasses and weeds.

The surface layer ranges from dark grayish brown to yellowish brown in color, from loam to sandy loam in texture, and from 8 to 14 inches in thickness. Below this layer is grayish-brown or light brownish-gray medium and coarse sand. These soils are moderately alkaline and range from slightly calcareous to strongly calcareous.

The Brazito soils occur in small areas throughout the Safford Area. They are near the Comoro, Anthony, and Arizo soils.

Brazito soils are irrigated and used for cultivated crops. These crops mainly are alfalfa, barley, sorghum, and pasture plants. Unirrigated areas are used for grazing cattle, but these areas produce little usable forage.

Brazito sandy loam (Bt).—This nearly level soil occurs as narrow strips on flood plains and alluvial fans in the inner valley. The surface is smooth, and slopes range from 0 to 2 percent.

Representative profile (SW¼SE¼ of section 12, T. 6 S., R. 24 E.):

Ap—0 to 10 inches, dark grayish-brown (10YR 4/2) sandy loam, dark brown (10YR 3/3) when moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; strongly effervescent; moderately alkaline (8.2); clear, smooth boundary.

C—10 to 50 inches, grayish-brown (10YR 5/2) to light brownish-gray (10YR 6/2) sand, dark brown (10YR 3/3) when moist; single grain; loose when moist or dry, nonsticky and nonplastic; few very fine roots; slightly effervescent to violently effervescent; moderately alkaline (pH 8.0).

Hues of the A and C horizons range from 7.5YR to 10YR. Values of these horizons range from 4 to 7 when the soil is dry and from 3 to 5 when the soil is moist. The A horizon contains less than 1 percent organic matter. The texture of the A horizon generally is sandy loam, but it ranges from loamy sand to loam. The texture of the C horizon generally is sand, but it ranges from loamy coarse sand to gravelly sand that is less than 30 percent fine gravel. In places very gravelly sand is below a depth of 36 inches.

Permeability below the surface layer of this soil is very rapid, and runoff is slow. The available moisture holding capacity is low. Roots penetrate to a depth of more than 60 inches. The organic-matter content and natural fertility are low. Although the surface layer is sandy loam, the hazard of water erosion and soil blowing is slight, even where the soil is left fallow.

Where this soil is irrigated, it is better suited to crops that are drought resistant. Pasture plants and alfalfa are better suited than cotton. Unirrigated areas are used for desert range, for water supply, and as a source of sand for making concrete products. Capability unit IVs–1 (irrigated), VIIs–3 (dryland).

Brazito loam (Br).—Except for having a loam surface layer, this soil is similar to Brazito sandy loam. Some small areas were included that have a clay loam surface layer. Slopes range from 0 to 2 percent. Runoff is medium to slow, and the available moisture holding capacity is low.

Where this soil is irrigated, it is suited to barley, sorghum, pasture plants, and alfalfa. Unirrigated areas are used for desert range, wildlife, and water supply. Capability unit IIIs–2 (irrigated), VIIs–3 (dryland).

Cave Series

The Cave series consists of well-drained, nearly level to moderately steep, calcareous soils that have a gravelly sandy loam surface layer. These soils are shallow or very shallow to a cemented layer of accumulated lime. They formed on the older terraces in mixed material that was rich in lime. These terraces have been eroded by intermittent washes and have gently sloping to steep sides and nearly level to rounded tops. Elevations range from 2,800 to 3,400 feet, and the average annual rainfall is about 9 inches. The vegetation is mainly creosotebush, ocotillo, cholla, and annual weeds and grasses.

The surface layer is light-brown to brown gravelly sandy loam 5 to 9 inches thick. Below this layer is pink to white gravelly loam or gravelly sandy loam. At a depth of 5 to 14 inches is a hard or very hard, white, gravelly, cemented layer of lime. This cemented layer ranges from 5 to 24 inches in thickness.

Cave soils are not generally suited to cultivated crops. Since water for irrigation is scarce, they are used only for desert range, wildlife, water supply, and recreation.

Cave gravelly sandy loam, 0 to 5 percent slopes (ChB).—This soil is on the edge of terraces and on ridges that are remnants of terraces above the inner valley.

Representative profile (300 feet east and 200 feet south of the northwest corner of section 15, T. 6 S., R. 24 E.):

A11—0 to 2 inches, pale-brown (10YR 6/3) gravelly sandy loam, dark brown (7.5YR 4/4) when moist; weak, thin and medium, platy structure that breaks to weak, fine, granular; slightly hard, friable, nonsticky and slightly plastic; few very fine roots; common, fine, tubular pores; strongly effervescent; mildly alkaline (pH 7.8); abrupt, smooth boundary.

A12—2 to 7 inches, light-brown (7.5YR 6/4) gravelly sandy loam, dark brown (7.5YR 4/4) when moist; massive; slightly hard, friable, slightly sticky and slightly plastic; plentiful very fine and few fine roots; few, very fine, tubular pores; strongly effervescent; moderately alkaline (pH 8.2); clear, wavy boundary.

C1ca—7 to 12 inches, pink (7.5YR 8/4) and white (N 8/0) gravelly loam, pink (7.5YR 7/4) when moist; many, fine, faint mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; plentiful very fine and fine roots; few, very fine, tubular pores; many fine and medium nodules of lime and lime-coated pebbles; violently effervescent; moderately alkaline (pH 8.2); abrupt, wavy boundary.

C2cam—12 to 24 inches, white (N 8/0) fine gravelly caliche pan strongly cemented with lime, pinkish white (7.5YR 8/2) when moist; caliche appears to be stratified and has a thin rocklike layer of lime on upper surface; massive; violently effervescent; moderately alkaline (pH 8.3).

Hues of the A and C horizons range from 7.5YR to 10YR. Values are greater than 5 in the A horizon when the soil is dry and are greater than 3 when the soil is moist. Chromas of this horizon range from 3 to 5. The A horizon ranges from gravelly sandy loam to loam or gravelly loam. Depth to the strongly cemented caliche ranges from 5 to 20 inches, and the volume of coarse fragments in this layer ranges from less than 10 to about 70 percent. The stratified caliche generally has one thick layer and as many as four or more thin layers, each separated by a thin layer of calcareous soil material. Generally, at least one layer of caliche at or near the upper part has a troweled surface. In some areas this soil has a layer of accumulated lime that is not cemented or only weakly cemented.

Permeability is very slow, and runoff is medium to rapid. The available moisture holding capacity is very low. Roots penetrate to a depth of 6 to 18 inches. The organic-matter content and natural fertility are low. Water erosion or soil blowing is not a problem.

This soil is not suited to cultivated crops. It is suited mainly to use as desert range for a few cattle, for wildlife, and for water supply; but it has limited use as recreational areas. Capability unit VIIs–7 (dryland).

Cave gravelly sandy loam, 5 to 30 percent slopes (ChE).—Except for having stronger slopes, this soil is similar to Cave gravelly sandy loam, 0 to 5 percent slopes. It is on the lower terraces above the inner valley and occupies long, narrow ridges that have rounded tops. The cemented layer of accumulated lime is discontinuous or lacking in areas where the slopes are steeper. Erosion ranges from slight to severe. The hazard of water erosion ranges from moderate to high, depending on slopes.

Included with this soil were some areas of Rough broken land. Also included were some areas on ridgetops where the layer of soil above the cemented layer is gravelly cobbly clay loam about 8 to 10 inches thick. In these areas cobblestones are on the surface.

This soil is used mainly for limited grazing by cattle and wildlife, but it is also used for water supply. Capability unit VIIe–1 (dryland).

Cave-Pinaleno complex, 0 to 20 percent slopes (CkD).—About 55 to 60 percent of this complex is Cave soil; 30 to 35 percent, Pinaleno soil; and 5 to 15 percent, included soils. The Cave soil has a profile similar to that of Cave gravelly sandy loam, 0 to 5 percent slopes. A representative profile for a Pinaleno soil is described for Pinaleno gravelly loam, 0 to 5 percent slopes.

The Cave soil in this complex is gently sloping on the rounded tops of ridges and is sloping to steep on the sides of the long, narrow ridges of terraces above the inner valley. In most places slopes are less than 10 percent. The Pinaleno soil is on hilltops and on terraces below the ridges. It has slopes that range from 0 to 5 percent. Included with this complex were areas of Arizo and Continental soils and of Riverwash and Rough broken land.

The soils of this complex are used for desert range, wildlife, and water supply. The vegetation provides some grazing. It consists mainly of creosotebush, cactus, and annual grasses and weeds. Capability unit VIIs–7 (dryland).

Cellar Series

The Cellar series consists of well-drained, nearly level to steep soils that are shallow or very shallow to granite bedrock. These soils formed in material that weathered from granite. Elevations range from 3,500 to 4,200 feet, and the average annual rainfall is about 11 inches. The vegetation is mainly snakeweed, catclaw, cactus, ocotillo, three-awn, lovegrass, and annual weeds and grasses.

The surface layer is mainly brown cobbly and very gravelly sandy loam 5 to 14 inches thick, but in some areas it is gravelly loamy sand. Below this layer is weathered granite bedrock or large boulders of detached bedrock.

Cellar soils are important producers of range forage and are used mainly for desert range. Other uses are for recreation, wildlife, and water supply.

Cellar soils, 2 to 50 percent slopes (ClF).—This undifferentiated group of soils is on the foothills and lower side slopes of the Pinaleno Mountains along the border between the survey area and the Coronado National Forest. The surface ranges from smooth to rough. Sand and gravelly material are in streambeds and the bottoms of washes.

Representative profile (SE¼SE¼ of section 22, T. 8 S., R. 25 E., on a low hill):

A1—0 to 9 inches, brown (10YR 5/3) cobbly and very gravelly sandy loam, dark yellowish brown (10YR 3/4) when moist; weak, fine, granular structure; slightly hard, friable, nonsticky and nonplastic; plentiful fine and medium roots; few to common, very fine, interstitial pores; neutral (pH 7.0); abrupt, wavy boundary.

R—9 to 16 inches +, partly weathered granite bedrock and granitic gneiss that are rich in mica.

Hues in the A1 horizon range from 7.5YR to 10YR. Values are less than 5.5 when the soil is dry and less than 3.5 when the soil is moist. Chromas are 4 or less. Texture of this horizon ranges from cobbly very gravelly sandy loam to gravelly sandy loam. Depth to bedrock ranges from 5 to 14 inches, and the number of stones ranges from few to many. The volume of gravel and cobblestones in the A1 horizon ranges from 50 to 70 percent.

Permeability is moderately rapid, and runoff is medium to rapid. The available moisture holding capacity is very low. Depth of root penetration generally is limited by bedrock, but the roots grow down through cracks to a depth of 24 to 36 inches. Soil blowing or water erosion is not a hazard if plant cover is maintained.

These soils are not suited to irrigated crops and are suited only to adapted range plants. They are used for desert range, for water supply, and for recreational areas. They support deer, rabbits, game birds, and other kinds of wildlife. Capability unit VIIs–6 (dryland).

Comoro Series

The Comoro series consists of well-drained, nearly level soils that have a loam or sandy loam surface layer. The underlying material is stratified. Elevations range from 2,600 to 3,200 feet, and the average annual rainfall is about 9 inches. In areas not cultivated, the vegetation is saltcedar, mesquite, willow, and annual weeds and grasses.

The surface layer ranges from brown to dark-brown loam or sandy loam in texture and from 10 to 14 inches in thickness. Below this layer is stratified, brown loamy fine sand to silt loam. In places sand and gravel are below a depth of 3 feet. These soils are moderately alkaline and generally are calcareous.

Comoro soils are along the Gila River and are important for growing cultivated crops. They are used for irrigated cotton, alfalfa, barley, sorghum, and pasture plants. They are also used for desert range, wildlife, and water supply.

Comoro sandy loam (Co).—This soil is on the flood plain of the Gila River. The surface is smooth, and slopes generally are less than 0.5 percent.

Representative profile (1,600 feet south and 600 feet east of the northwest corner of section 21, T. 6 S., R. 25 E.):

Ap—0 to 12 inches, brown (7.5YR 5/2) sandy loam, dark brown (7.5YR 3/2) when moist; massive; slightly hard, very friable, nonsticky and slightly plastic; few very fine roots; common, very fine, interstitial pores; slightly effervescent; moderately alkaline (pH 8.0); clear, smooth boundary.

C1—12 to 30 inches, brown (7.5YR 5/2) fine sandy loam, dark brown (7.5YR 3/2) when moist; massive; slightly hard, friable, nonsticky and slightly plastic; few very fine roots; common, very fine interstitial pores; slightly effervescent; moderately alkaline (pH 8.0); abrupt, wavy boundary.

IIC2—30 to 42 inches, brown (7.5YR 5/2) loamy fine sand, dark brown (7.5YR 3/2) when moist; massive; soft, very friable, nonsticky and nonplastic; few very fine and fine roots; many, very fine, interstitial pores; noneffervescent; moderately alkaline (pH 8.0); clear, wavy boundary.

IIIC3—42 to 47 inches +, brown (7.5YR 5/2) loam or silt loam, dark brown (7.5YR 3/2) when moist; massive; slightly hard, friable, sticky and plastic; few very fine roots; common, very fine, interstitial pores; strongly effervescent; moderately alkaline (pH 8.0).

The Ap horizon has hues that range from 7.5YR to 10YR. Values are less than 5.5 when the soil is dry and are less than 3.5 when the soil is moist. The Ap horizon ranges from fine sandy loam to sandy loam or loamy very fine sand. In

the C1 and IIC2 horizons the texture ranges from fine sandy loam to loamy fine sand, and in places there are many thin strata ranging from silt loam to loamy sand. This soil generally is dark colored to a depth of 36 inches or more.

Included with this soil were small areas of Gila, Grabe, and Anthony soils.

Permeability below the surface layer is moderately rapid, and runoff is slow. The available moisture holding capacity is fair. Roots can penetrate to a depth of more than 60 inches. The organic-matter content is moderate, and natural fertility is medium. Soil blowing is not a hazard, and water erosion is a hazard only when the floodwaters of the river are high.

This soil has good tilth and is easily worked. Cotton, alfalfa, barley, and all other crops suited to the survey area can be grown under irrigation. This soil is also used for desert range, wildlife, and water supply. Capability unit IIs–6 (irrigated), VIIs–1 (dryland).

Comoro loam (Cm).—Except for having a loam surface layer, this soil is similar to Comoro sandy loam and is near that soil. This soil is on the flood plain of the Gila River.

Cotton, alfalfa, barley, and all other adapted crops can be grown on this soil under irrigation. In areas not irrigated, the vegetation is mainly saltcedar and annual plants. These areas are used for desert range, wildlife, and water supply. Capability unit IIs–3 (irrigated), VIIs–1 (dryland).

Comoro loam, mottled variant (Cn).—This soil formed on excessively wet old alluvial fans and flood plains in washes south of Safford. Although this soil is no longer wet, it is gray in color and has yellowish-brown and gray mottles in the lower part. The surface is smooth, and slopes generally are less than 1 percent. This soil is near the Gila, Anthony, and Pima soils.

Representative profile (550 feet east and 300 feet south of the west quarter corner of section 17, T. 8 S., R. 26 E.):

A1—0 to 9 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; massive; slightly hard, friable, slightly sticky and plastic; slightly effervescent; moderately alkaline (pH 8.2); abrupt, smooth boundary.

C1—9 to 18 inches, dark grayish-brown (10YR 4/2) sandy loam, very dark grayish brown (10YR 3/2) when moist; massive; soft, very friable, nonsticky and nonplastic; slightly effervescent; moderately alkaline (pH 8.2); clear, wavy boundary.

C2g—18 to 27 inches, mottled strong-brown (7.5YR 5/6) and gray (10YR 6/1) fine sandy loam, strong brown (7.5YR 5/6) and gray (10YR 5/1) when moist; mottles are common, fine and medium, and distinct; massive; slightly hard, very friable, nonsticky and nonplastic; moderately alkaline (pH 8.2); abrupt, wavy boundary.

IIC3g—27 to 36 inches, mottled gray (10YR 6/1) and yellowish-brown (10YR 5/6) loamy sand, grayish brown (10YR 5/2) and yellowish brown (10YR 5/8) when moist; mottles are common, fine and medium, and distinct; massive; soft, very friable, nonsticky and nonplastic; moderately alkaline (pH 8.2); abrupt, wavy boundary.

IIIC4g—36 to 60 inches, mottled gray (10YR 6/1) and strong-brown (7.5YR 5/6) sandy loam, very dark gray (10YR 3/1) and strong brown (7.5YR 5/6) when moist; mottles are common to many, medium and coarse, and distinct; massive; slightly hard, very friable, nonsticky and nonplastic; moderately alkaline.

The A1 horizon ranges from 8 to 12 inches in thickness. In places thin strata of sand and gravel occur below a depth of 2 feet.

Included with this soil were small areas that have a sandy loam surface layer.

This soil is irrigated and used for cotton, alfalfa, and most other crops. It is better suited to irrigated pasture. Harmful soluble salts can be removed easily by leaching the soil with irrigation water. Unirrigated areas are used for desert range, wildlife, and water supply. Capability unit IIs–3 (irrigated), VIIs–1 (dryland).

Continental Series

The Continental series consists of well-drained, nearly level to gently sloping to sloping soils that have a gravelly sandy loam or cobbly sandy loam surface layer. These soils range from shallow to deep to a weakly to strongly cemented layer of accumulated lime. They occur along both sides of the Gila River on terraces above the inner valley. Elevations range from 2,800 to 4,800 feet, and the average annual rainfall ranges from about 9 inches on the lower terraces to 11 inches on the higher terraces. The vegetation consists of creosotebush, catclaw, whitethorn, snakeweed, tobosa, ocotillo, cholla, and annual weeds and grasses.

The surface layer ranges from brown to reddish brown in color, from gravelly sandy loam to cobbly sandy loam in texture, and from 2 to 7 inches in thickness. The subsoil is dark-red to yellowish-red gravelly clay loam to cobbly clay. The substratum is at a depth of about 29 inches. It is made up of weakly to strongly lime-cemented gravel.

The Continental soils occur with the Cave, Gila, and Anthony soils.

The Continental soils are not irrigated. They are used for desert range, wildlife, water supply, and recreation. At higher elevations, these soils produce more forage for cattle than they do at lower elevations.

Continental-Gila gravelly sandy loams, 0 to 5 percent slopes (CsB).—About 60 to 65 percent of this complex is Continental soil; 25 to 30 percent, Gila soil; and 5 to 15 percent, included soils. A representative profile for a Gila soil is described under the Gila series.

Representative profile of a Continental soil (1,200 feet east of the south quarter corner of section 30, T. 7 S., R. 25 E.):

A1—0 to 2 inches, reddish-brown (5YR 4/4) gravelly sandy loam, dark reddish brown (5YR 3/4) when moist; weak, medium, platy structure; slightly hard, very friable, nonsticky and slightly plastic; abundant very fine roots; plentiful, very fine, interstitial pores; neutral (pH 7.0); abrupt, smooth boundary.

B21t—2 to 5 inches, red (2.5YR 4/6) gravelly clay loam, dark red (2.5YR 3/6) when moist; moderate, medium and coarse, subangular blocky structure; hard, friable, slightly sticky and plastic; plentiful very fine and fine roots; few, very fine and fine, tubular and many, very fine, interstitial pores; thin continuous clay films on ped faces and in pores; neutral (pH 7.0); clear, smooth boundary.

IIB22t—5 to 11 inches, dark-red (2.5YR 3/6) cobbly clay, dark red (2.5YR 3/6) when moist; weak, medium, prismatic structure that breaks to moderate, medium, subangular blocky; hard, friable, slightly sticky and very plastic; plentiful very fine and fine and few

large roots; few, very fine and fine, tubular and many, very fine, interstitial pores; thin continuous clay films on ped faces and in pores; mildly alkaline (pH 7.5); gradual, smooth boundary.

IIIB23tca—11 to 29 inches, yellowish-red (5YR 4/6) gravelly clay, yellowish red (5YR 4/6) when moist; common, fine and medium, lime mottles of pink and reddish yellow; moderate, fine and medium, subangular blocky and angular blocky structure; hard, friable, slightly sticky and very plastic; plentiful very fine and fine and few medium roots; few, very fine and fine, tubular and many, fine, interstitial pores; few thin patchy clay films in pores and on ped faces; slightly or strongly effervescent; moderately alkaline (pH 8.0); gradual, wavy boundary.

IVCcam—29 to 50 inches, reddish-yellow (5YR 7/6) and white (N 8/0) strongly cemented cobbly and gravelly caliche, yellowish red (5YR 5/6) and pinkish white (5YR 8/2) when moist; massive; extremely hard; few medium roots; common, very fine, tubular pores; violently effervescent; moderately alkaline (pH 8.0).

Hues of the A1 horizon range from 5YR to 7.5YR. Values range from 4 to 5 when the soil is dry and from 3 to 4 when the soil is moist. Hues of the B horizons range from 2.5YR to 5YR. Texture of the A1 horizon is dominantly gravelly sandy loam, but it ranges from gravelly loam to cobbly sandy loam. The texture of the B horizons ranges from gravelly clay loam to clay. Structure of the B horizons ranges from moderate, medium, prismatic to weak, medium, subangular blocky or massive. The volume of coarse fragments ranges from less than 10 percent to about 45 percent. Depth to the layer of accumulated lime ranges from about 2 to more than 3 feet, and cementation ranges from weak to strong. In some places this layer is discontinuous; in other places it is indurated.

Permeability of this soil is moderately slow. The available moisture capacity is fair. The organic-matter content is low, and natural fertility is medium to high. There is little hazard of soil blowing or water erosion.

The Continental soil in this complex is on terraces above the inner valley. The Gila soil is in drainageways and on alluvial fans. Included with this complex were areas of Bitter Spring and Anthony soils and of Gravelly alluvial land and Rough broken land.

The soils of this complex are used for desert range, wildlife, and water supply. The natural vegetation provides some grazing. It consists mainly of creosotebush and annual weeds and grasses, but there is some cholla, ocotillo, whitethorn, and catclaw. Scattered mesquite grows in drainageways. Capability unit VIIs–7 (dryland).

Continental cobbly sandy loam, 2 to 5 percent slopes (CrB).—Except for cobblestones covering 15 to 40 percent of the surface and making up 15 to 40 percent of the subsoil, the profile of this soil is similar to the profile described for Continental soil in Continental-Gila gravelly sandy loams, 0 to 5 percent slopes. This soil occurs on a broad alluvial fan on the higher terraces. The cobblestones on the surface interfere somewhat with the movement of farm animals and vehicles.

This soil is used for desert range, wildlife, and water supply. In some areas grazing can be improved by seeding Lehmann lovegrass or other drought-resistant grasses. Capability unit VIIs–4 (dryland).

Continental-Pinaleno complex, 0 to 5 percent slopes (CtB).—About 55 percent of this complex is Continental soil; 25 to 30 percent, Pinaleno soil; and 15 to 20 percent, included soils. The Continental soil has a profile similar to the profile described for the Continental soil in Continental-Gila gravelly sandy loams, 0 to 5 percent slopes. A representative profile for a Pinaleno soil is described for Pinaleno gravelly loam, 0 to 5 percent slopes.

The Continental soil in this complex is on terraces and low ridges of terraces above the inner valley. The Pinaleno soil is on ridges and alluvial fans on the terraces. Included with this complex in mapping were areas of Bitter Spring, Arizo, and Cave soils and of Rough broken land.

The soils of this complex are used for desert range, wildlife, and water supply. The natural vegetation provides some grazing. It consists mainly of wolfberry, snakeweed, mesquite, cholla, and annual grasses and weeds, but some tobosa grows in swales, and creosotebush on fans and in steeper areas. Capability unit VIIs–4 (dryland).

Gila Series

The Gila series consists of well-drained, nearly level or gently sloping soils that have a loam, sandy loam, gravelly loam, or gravelly sandy loam surface layer. The underlying material is loam or silt loam. These soils formed in mixed material deposited on flood plains and alluvial fans by streams and washes. Elevations range from 2,600 to 3,200 feet, and the average annual rainfall is about 9 inches. In areas not cultivated the vegetation is creosotebush, mesquite, saltbush, and annual weeds and grasses.

The surface layer ranges from grayish-brown loam to pale-brown gravelly sandy loam and from 6 to 16 inches in thickness. Below this layer is brown loam, silt loam, or very fine sandy loam that generally is stratified. These soils are calcareous throughout their profile.

The Gila soils are near the dark-colored Grabe soils and the Aqua soils.

Gila soils are used for irrigated cotton, alfalfa, sorghum, small grains, and pasture plants. Other uses are for desert range and water supply.

Gila loam, 0 to 2 percent slopes (GcA).—This soil occurs on flood plains and alluvial fans, mainly around the edges of the inner valley. The surface is smooth, and slopes generally are less than 0.5 percent.

Representative profile (1,200 feet south and 200 feet east of the west quarter corner of section 6, T. 6 S., R. 25 E., in a cultivated field):

Ap—0 to 6 inches, grayish-brown (10YR 5/2) loam, dark brown (10YR 4/3) when moist; massive; slightly hard, friable, slightly sticky and plastic; plentiful very fine roots; common, very fine, tubular and few, very fine, interstitial pores; strongly effervescent; moderately alkaline (pH 8.0); abrupt, wavy boundary.

C1—6 to 27 inches, brown (10YR 5/3) silt loam or loam, dark brown (10YR 4/3) when moist; massive; hard, friable, slightly sticky and plastic; plentiful very fine roots; common, very fine and fine, tubular pores; few very fine mycelialike veins of lime; strongly effervescent; moderately alkaline (pH 8.0); abrupt, wavy boundary.

C2&C3—27 to 66 inches, brown (10YR 5/3) silt loam, dark brown (10YR 4/3) when moist; below a depth of 39 inches are strata of gravelly sandy loam 1 to 12 inches thick; massive; hard, friable, slightly sticky and plastic to a depth of 39 inches, nonsticky to

sticky and nonplastic below 39 inches; few medium roots to a depth of 39 inches; common, very fine, tubular pores; few very fine mycelia of lime below a depth of 39 inches; strongly effervescent; moderately alkaline (pH 8.0).

Hues of the Ap, C1, and C2&C3 horizons range from 7.5YR to 10YR. Values of the Ap horizon range from 5 to 7 when the soil is dry and from 3 to 5 when the soil is moist. Chromas range from 2 to 4 when the soil is moist. Texture of the Ap horizon generally is loam, but it ranges from silt loam to very fine sandy loam. In places the C horizons are uniform loam or very fine sandy loam, but frequently these horizons contain thin layers ranging in texture from silt loam to sandy loam. In some places gravelly sandy loam or sand is below a depth of 40 inches.

Permeability of this soil is moderate, and runoff is slow. The available moisture holding capacity is good. Roots penetrate to a depth of more than 60 inches. The organic-matter content is low, and natural fertility is medium to high. Water erosion or soil blowing is not a hazard.

All irrigated crops suited to the survey area can be grown on this soil. Cotton, alfalfa, pasture plants, and fruit and nut trees are suited. This is one of the better, more easily managed soils in the inner valley. Unirrigated areas are used for desert range, wildlife, and water supply. Capability unit I–1 (irrigated), VIIc–1 (dryland).

Gila gravelly loam, 0 to 2 percent slopes (GbA).—Except for having gravel in the surface layer, this soil is similar to Gila loam, 0 to 2 percent slopes. The surface layer to a depth of 8 to 12 inches is more than 15 percent gravel, but this gravel does not interfere with tillage. Because areas of this soil are small, removal of most of the larger pebbles is practical. There is little or no soil blowing or water erosion on this soil.

This soil is suited to all irrigated crops commonly grown in the survey area. Unirrigated areas are used for desert range, wildlife, and water supply. Capability unit I–3 (irrigated), VIIc–1 (dryland).

Gila loam, 2 to 5 percent slopes (GcB).—This soil is on the edge of low terraces above the inner valley. Except that it is gently sloping, this soil is similar to Gila loam, 0 to 2 percent slopes. The texture of the surface layer dominantly is loam, but in some small areas it is sandy loam. The surface layer ranges from 7 to 10 inches in thickness. Runoff is slow to medium. There is little or no hazard of soil blowing or water erosion if plant cover is maintained.

Since sufficient water is not available for irrigation, this soil is not used for cultivated crops. The vegetation is mainly creosotebush, mesquite, and annual weeds and grasses. This vegetation provides limited grazing where the soil is used for desert range. Other uses are for wildlife and water supply, for which this soil is well suited. Capability unit VIIc–1 (dryland).

Gila loam, saline, 0 to 2 percent slopes (GeA).—Except for having soluble salts throughout the profile, this soil is similar to Gila loam, 0 to 2 percent slopes. This soil contains enough soluble salts to reduce germination and growth of most crops. Most of these salts can be removed, however, by leaching with irrigation water. The available moisture holding capacity of this soil is good. Runoff is medium. The hazard of water erosion is slight.

Before the content of salts is reduced by leaching, this soil is suited to barley, sorghum, and adapted pasture plants. Unleached areas are also used for wildlife and water supply. This soil can be used for sewage-disposal fields, building sites, and most other nonfarm purposes without leaching. Capability unit IIs–1 (irrigated), VIIs–2 (dryland).

Gila sandy loam, 0 to 2 percent slopes (GfA).—This soil is on the flood plain of the Gila River and on alluvial fans in washes in the inner valley. Except for having a sandy loam surface layer, this soil is similar to Gila loam, 0 to 2 percent slopes. The surface layer is sandy loam to a depth of 8 to 14 inches. The available moisture holding capacity is good. There is little or no hazard of soil blowing or water erosion if plant cover is maintained.

The principal irrigated crops grown on this soil are cotton, alfalfa, sorghum, small grains, and pasture plants. Where this soil is not irrigated, it is suited only to limited grazing by cattle. Other uses are for wildlife and water supply. Capability unit I–3 (irrigated), VIIc–1 (dryland).

Gila and Glendale soils, 0 to 2 percent slopes (GgA).—This undifferentiated group of soils is on flood plains and alluvial fans in the larger washes in unirrigated areas of the inner valley. The texture of the surface layer of soils in this mapping unit ranges from silt loam to gravelly sandy loam. These soils are variable in texture, and they have not been mapped separately. The Gila and Glendale soils make up about 90 percent of this mapping unit, and the Anthony and Brazito soils and Riverwash make up the remaining 10 percent. Slight to moderate erosion is evident in the form of arroyos, gullies, and irregular hollows, or pipes.

The soils of this group are not used for cultivated crops. The vegetation provides some grazing. It consists mainly of saltbush and creosotebush and some mesquite, whitethorn, saltcedar, and cholla. These soils are also used for wildlife and, in some places, for garbage dumps. Capability unit VIIc–1 (dryland).

Glendale Series

The Glendale series consists of well-drained, nearly level soils that have a loam, silt loam, or silty clay loam surface layer. The underlying layer is clay loam or silty clay loam. In many places the Glendale soils are saline or saline-alkali. These soils formed in mixed materials deposited on flood plains and alluvial fans by streams. They are in the higher parts of the inner valley. Elevations range from 2,600 to 3,000 feet, and the average annual rainfall is about 9 inches. In areas not cultivated, the vegetation is saltbush, creosotebush, saltcedar, and annual weeds and grasses.

The surface layer ranges from pale-brown silt loam to light brownish-gray silty clay loam in texture and from 8 to 16 inches in thickness. Below this layer is pale-brown to grayish-brown silty clay loam or clay loam. In some areas the lower material is stratified. These soils are calcareous throughout their profile.

The Glendale soils are near the Gila soils.

Glendale soils are irrigated and used for cultivated crops, mainly cotton, barley, sorghum, alfalfa, and pasture plants. Unirrigated areas are used for desert range, wildlife, and water supply.

Glendale loam (Gm).—This soil occurs on flood plains of streams and washes along the southern side of the inner valley. Slopes range from 0 to 2 percent.

Representative profile (400 feet east of the northwest corner of section 5, T. 8 S., R. 26 E.):

A1—0 to 8 inches, light brownish-gray (10YR 6/2) loam, dark brown (10YR 4/3) when moist; upper 0.5 inch has weak, medium, platy structure and lower 7.5 inches is massive; slightly hard, friable, slightly sticky and slightly plastic; plentiful very fine roots; few, very fine and fine, interstitial pores; strongly effervescent; moderately alkaline (pH 8.0); abrupt, smooth boundary.

C1—8 to 18 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) when moist; massive; very hard, friable, slightly sticky and plastic; few very fine and fine roots; few, very fine and fine, tubular and few, fine, interstitial pores; strongly effervescent; moderately alkaline (pH 8.0); clear, smooth boundary.

C2—18 to 42 inches, grayish-brown (10YR 5/2) silty clay loam or clay loam, dark brown (10YR 4/3) when moist; massive; very hard, friable, sticky and plastic; few very fine and fine roots; few, very fine, tubular pores; common to many, very fine and fine, distinct, white (N 8/0), myceliallike veins and accumulations of salt; strongly effervescent; moderately alkaline (pH 8.0).

Hues of the A1, C1, and C2 horizons range from 7.5YR to 10YR. Values of the A1 horizon range from 5 to 7 when the soil is dry and from 4 to 5 when the soil is moist. Chromas range from 2 to 4. The C1 and C2 horizons range from loam to silty clay loam in texture but are dominantly clay loam. In places this soil contains strata of coarser or finer textured material below the C1 and C2 horizons.

Included with this soil were small areas that have a clay loam surface layer.

Permeability of this soil is moderately slow, and runoff is slow. The available moisture holding capacity is good. Roots can penetrate to a depth of more than 60 inches. The organic-matter content is low, and natural fertility is medium. There is little or no hazard of soil blowing or water erosion.

Only a small acreage of this soil is used for irrigated crops of cotton, alfalfa, barley, sorghum, and pasture plants. Where this soil has not been irrigated, it contains soluble salts in the lower part. In areas converted from range to cultivation, tall wheatgrass or other salt-tolerant crops can be grown until the salts are leached out. Then, this soil can be used for most irrigated crops. Unirrigated areas are used for desert range, wildlife, and water supply. Capability unit I-1 (irrigated), VIIc-1 (dryland).

Glendale silt loam, saline (Gn).—This nearly level soil is mainly southwest of the Gila River between Pima and Fort Thomas on flood plains and alluvial fans of streams and washes. Except for having a silt loam surface layer and soluble salts throughout the profile, this soil is similar to Glendale loam. Slopes generally are less than 0.5 percent.

Permeability is moderately slow, and runoff is medium to rapid. The available moisture holding capacity is good. In most areas salinity is moderate to severe, and a few small areas are alkali. The hazard of erosion is slight to moderate.

Included with this soil were small areas that are not saline and some that are not alkali. Also included were areas that have sand or gravel below a depth of 2 feet.

This soil is used mainly for irrigated crops. All crops adapted to the survey area are grown, but the better suited ones are barley and salt-tolerant grasses. The natural vegetation provides little grazing for cattle, and most unirrigated areas are used for water supply. Capability unit IIs-2 (irrigated), VIIs-2 (dryland).

Glendale silt loam, saline-alkali (Go).—Except that it has a silt loam surface layer and is saline-alkali, this soil is similar to Glendale loam. Sodium (alkali) in this soil causes it to disperse readily and reduces permeability. The available moisture holding capacity is good. Runoff is medium to rapid, and the hazard of erosion is slight to moderate. Slopes range from 0 to 2 percent.

This soil is irrigated and used for all cultivated crops commonly grown, but it is better suited to salt-tolerant grasses. Unirrigated areas provide little range forage. This soil is poor for use as structural material. Capability unit IIs-2 (irrigated), VIIs-2 (dryland).

Glendale silty clay loam, saline (Gp).—Except for having a silty clay loam surface layer and soluble salts throughout the profile, this soil is similar to Glendale loam. The available moisture holding capacity is good. Runoff is medium to rapid, and the hazard of erosion is slight to moderate. Slopes range from 0 to 2 percent.

Included with this soil were some small areas that have a silt loam subsoil. Also included were small areas that are not saline.

This soil is used for irrigated crops. Unirrigated areas provide limited grazing for cattle and are used for wildlife and water supply. Capability unit IIs-2 (irrigated), VIIs-2 (dryland).

Grabe Series

The Grabe series consists of well-drained, nearly level soils that have a clay loam or loam surface layer. These soils formed in mixed material deposited on the flood plain of the Gila River and on alluvial fans and flood plains in the inner valley. Elevations range from 2,600 to 3,200 feet, and the average annual rainfall is about 9 inches. In areas not cultivated the vegetation is mainly saltcedar, willow, mesquite, johnsongrass, and annual grasses and weeds.

The surface layer commonly ranges from 10 to 20 inches in thickness and from brown clay loam to grayish-brown loam in texture. The underlying material commonly is grayish-brown loam and very fine sandy loam that is stratified in places. In some areas sand and gravel are below a depth of 3 feet. In most places these soils are calcareous throughout their profile.

These soils occur with the light-colored Gila soils.

Grabe soils are mainly irrigated and are used for all adapted crops including cotton, sorghum, alfalfa, barley, and pasture plants. A few areas are used for desert range, wildlife, and water supply.

Grabe clay loam (Gr).—This nearly level soil occurs on flood plains and alluvial fans in the inner valley. The surface is smooth, and slopes generally are less than 0.5 percent.

Representative profile (1,400 feet south and 1,600 feet west of the east quarter corner of section 17, T. 7 S., R. 26 E.):

Ap1—0 to 11 inches, brown (7.5YR 5/2) clay loam, dark brown (7.5YR 3/2) when moist; massive; very hard, friable, sticky and plastic; few very fine and medium roots; common fine pores; few, medium, tubular pores and many, very fine, interstitial pores; strongly effervescent; moderately alkaline (pH 8.0); clear, smooth boundary.

Ap2—11 to 20 inches, brown (7.5YR 5/2) loam, dark brown (10YR 3/3) when moist; massive; hard, friable, sticky and plastic; plentiful very fine and fine and few medium roots; many, very fine and fine, tubular pores; slightly effervescent; moderately alkaline (pH 8.0); clear, wavy boundary.

C1—20 to 34 inches, brown (10YR 5/3) loam, dark brown (7.5YR 4/2) when moist; massive; hard, friable, slightly sticky and plastic; few very fine roots; many, very fine and fine, tubular pores; strongly effervescent; moderately alkaline (pH 8.0); gradual, wavy boundary.

C2—34 to 66 inches, brown (10YR 5/3) sandy loam or loam, dark brown (7.5YR 4/2) when moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many, very fine and fine, tubular pores; slightly effervescent; moderately alkaline (pH 8.0).

Hues of the A and C horizons range from 7.5YR to 10YR. Values of the A horizon are less than 5.5 when the soil is dry and less than 3.5 when the soil is moist. Chromas range from 2 to 4. Values of the C horizons range from 5 to 6 when the soil is dry and from 3 to 4 when the soil is moist. Texture of the A horizons dominantly is clay loam, but it ranges from clay loam to silty clay loam. The texture of the Ap2, C1, and C2 horizons ranges from uniform loam to very fine sandy loam, but these horizons contain thin strata of sandy loam, gravelly sandy loam, or clay loam. In some places gravelly sandy loam is below a depth of 36 inches.

Permeability of this soil is moderate, and runoff is slow. The available moisture holding capacity is good. Roots penetrate to a depth of more than 60 inches. The organic-matter content is moderately low, and natural fertility is high. There is little or no hazard of soil blowing or water erosion.

This soil is used for irrigated crops consisting chiefly of cotton, sorghum, barley, alfalfa, and grasses. Capability unit I–2 (irrigated).

Grabe loam (Gs).—Except for having a loam surface layer, this soil is similar to Grabe clay loam. Slopes range from 0 to 2 percent. The surface layer ranges from 12 to 16 inches in thickness. The available moisture holding capacity is good.

Nearly all the acreage of this soil is irrigated and used for cotton, alfalfa, barley, sorghum, and other crops for which it is well suited. Areas not cultivated are used for desert range, wildlife, and water supply. Capability unit I–1 (irrigated), VIIc–1 (dryland).

Grabe loam, saline (Gt).—Except for having a loam surface layer and soluble salts throughout the profile, this soil is similar to Grabe clay loam. The surface layer ranges from 12 to 16 inches in thickness. Slopes range from 0 to 2 percent. This soil contains enough soluble salts to reduce germination and growth of most crops. Most of the salts can be removed, however, by leaching with irrigation water. The available moisture holding capacity is good, and runoff is medium.

In areas not cultivated the vegetation consists mainly of saltcedar, Russian-thistle, and pickleweed. Before the content of salt is reduced by leaching, this soil can be used for barley and adapted pasture plants. Unleached areas are also used for wildlife and water supply. This soil can be used for sewage-disposal fields, building sites, and most other nonfarm purposes without leaching. Capability unit IIs–1 (irrigated), VIIs–2 (dryland).

Graham Series

The Graham series consists of shallow, well-drained soils that have a gravelly or cobbly clay loam surface layer. These soils are shallow to basaltic bedrock, and outcrops of bedrock are common. They formed in material that weathered from basalt in the Gila Mountains. Elevations range from 3,600 to 4,500 feet, and the average annual rainfall is about 11 inches. The vegetation generally grows better on north-facing slopes and consists mainly of tobosa, three-awn, ocotillo, pricklypear, huajillo, side-oats grama, snakeweed, and annual weeds.

The surface layer is reddish-brown gravelly or cobbly clay loam 1 or 2 inches thick. The subsoil is dark reddish-brown gravelly clay loam or gravelly clay. The thickness of the surface layer and subsoil combined ranges from 8 to 20 inches. Bedrock is at a depth of 8 to 20 inches. These soils generally are noncalcareous, but in places they have a thin layer of accumulated lime on top of the bedrock.

Graham soils are important for producing range forage. These soils are used mainly for desert range, wildlife, and water supply.

Graham extremely rocky clay loam, 2 to 40 percent slopes (GuE).—About 55 to 60 percent of this mapping unit is Graham cobbly clay loam, and 40 to 45 percent is rock outcrops and talus, or sloping mounds of rock debris at the foot of steep outcrops. The rock outcrops and talus are on the steep side slopes and craggy tops of the Gila Mountains, and shallow Graham cobbly clay loam is on the less sloping parts of the mountains between the outcrops.

Representative profile (600 feet south and 200 feet east of the northwest corner of section 22, T. 6 S., R. 27 E., on a slope facing south):

A1—0 to 1 inch, reddish-brown (5YR 4/3) very cobbly clay loam, dark reddish brown (5YR 3/3) when moist; weak, fine, crumb structure; slightly hard, friable, slightly sticky and slightly plastic; plentiful very fine and fine roots; common, fine, interstitial and very few, fine, tubular pores; neutral (pH 7.0); clear, smooth boundary.

B21t—1 to 6 inches, dark reddish-brown (5YR 3/3) gravelly clay loam, dark reddish brown (5YR 3/3) when moist; weak, fine and medium, subangular blocky structure; hard, firm, sticky and plastic; few very fine and plentiful fine roots; few, fine, interstitial and tubular pores; common, thin, patchy clay films on ped faces; mildly alkaline (pH 7.5); clear, smooth boundary.

B22t—6 to 14 inches, dark reddish-brown (5YR 3/3) gravelly clay, dark reddish brown (5YR 3/3) when moist; weak, coarse, subangular blocky structure that breaks to moderate, medium, subangular blocky; very hard, very firm, sticky and very plastic; few fine roots; common, fine, interstitial and few, very fine and fine, tubular pores; thin patchy clay films on ped faces; slightly effervescent; moderately alkaline (pH 8.0); clear, irregular boundary.

R—14 to 16 inches, extremely hard basalt bedrock; slight effervescence on broken surfaces; increases with increasing depth.

Hues of the A and B horizons range from 5YR to 7.5YR. Values are less than 5.5 when the soil is dry and less than 3.5

when the soil is moist. Chromas range from 2 to 4. The surface layer ranges from cobbly to stony, and the cobblestones in the upper 1 or 2 inches are mostly exposed. The B horizon ranges from gravelly clay loam to stony clay. The solum ranges from 8 to 20 inches in thickness.

Permeability of this soil is moderately slow to slow, and runoff is medium to rapid. The available moisture holding capacity is very low. Root penetration is limited by the bedrock, but in places where the bedrock is fractured the roots penetrate into cracks to a depth of 24 to 36 inches. The organic-matter content is moderately low, and natural fertility is medium to high. If plant cover is maintained, there is little or no hazard of soil blowing or water erosion.

This soil is used for desert range, wildlife, and water supply, for which it is well suited. Capability unit VIIs-5 (dryland).

Gravelly Alluvial Land

Gravelly alluvial land (Gv) consists of gravelly, cobbly, and sandy alluvium deposited on broad fans and on flood plains of washes. This land type occurs on the lower terraces above the inner valley. Slopes range from 2 to 5 percent. Elevations range from 2,900 to 3,300 feet, and the average annual rainfall is about 9 inches. Roots can penetrate to a depth of more than 60 inches. The vegetation is mostly creosotebush and annual weeds and grasses, but mesquite, whitethorn, and desert broom grow on the bottom of washes and in large streambeds.

Gravelly alluvial land has limited use for grazing by cattle and wildlife. It is also used for water supply, and some areas provide good subgrade material for building roads. Capability unit VIIs-3 (dryland).

Guest Series

The Guest series consists of deep, well-drained, nearly level soils that have a clay surface layer. These soils formed in mixed materials deposited on flood plains and alluvial fans in the inner valley. In some places the underlying material is stratified. Elevations range from 2,700 to 3,000 feet, and the average annual rainfall is about 9 inches. All the acreage of these soils is cultivated, and the vegetation includes most cultivated crops grown in the survey area.

The surface layer ranges from dark grayish brown to grayish brown in color, from clay to clay loam in texture, and from 10 to 16 inches in thickness. Below the surface layer is a layer of brown or dark-brown clay or clay loam that generally extends to a depth of 5 feet or more. In some places this layer contains strata that range from sandy loam to clay loam, and in other places it overlies material that ranges from sandy loam to clay loam at a depth below 2 feet.

Guest soils are used mainly for irrigated crops of cotton, sorghum, and small grains, but they are well suited to pasture plants and other crops used for feeding livestock. These soils are poorly suited for building earthen structures, because they shrink and swell when the moisture content decreases or increases.

Guest clay (Gy).—This soil is deep, well drained, and nearly level. The largest area is south of the Gila River between Lone Star and Solomon. Slopes generally are less than 0.5 percent.

Representative profile (300 feet south and 150 feet east of the west quarter corner of section 19, T. 7 S., R. 27 E.):

Ap1—0 to 1 inch, dark grayish-brown (10YR 4/2) clay loam, dark brown (10YR 3/3) when moist; moderate, very fine and fine, granular structure; slightly hard, friable, sticky and plastic; many very fine roots; strongly effervescent; moderately alkaline (pH 8.0); abrupt, smooth boundary.

Ap2—1 to 16 inches, grayish-brown (10YR 5/2) clay, dark yellowish brown (10YR 3/4) when moist; massive; hard, friable, sticky and plastic; many very fine and fine roots; common, very fine and few, medium, tubular pores; strongly effervescent; moderately alkaline (pH 8.0); clear, smooth boundary.

C1—16 to 38 inches, brown (7.5YR 4/2) clay, brown (7.5YR 4/4) when moist; massive; very hard, firm, sticky and plastic; strongly effervescent; moderately alkaline (pH 8.0); abrupt, wavy boundary.

C2—38 to 42 inches, brown (7.5YR 4/2) clay loam, brown (7.5YR 4/4) when moist; massive; hard, friable, sticky and plastic; strongly effervescent; moderately alkaline (pH 8.0); abrupt, wavy boundary.

C3—42 to 56 inches, brown (7.5YR 4/2) clay, brown (7.5YR 4/4) when moist; massive; hard, friable, sticky and plastic.

Hues of the A and C horizons range from 7.5YR to 10YR. Values of the A horizons are less than 5.5 when the soil is dry and less than 3.5 when the soil is moist. Chromas in these horizons range from 2 to 4. Values of the C horizons range from 4 to 6 when the soil is dry and from 3 to 4 when the soil is moist. Texture of the A horizons ranges from loam to clay. The C1, C2, and C3 horizons range from clay loam to clay, and in places they contain strata of coarser material less than 2 inches thick.

Included with this soil were small areas of Grabe, Comoro, and Pima soils.

Permeability and runoff are slow. The available moisture holding capacity is good. Roots penetrate to a depth of more than 60 inches. The organic-matter content is moderately low, and natural fertility is medium. There is little or no hazard of soil blowing or water erosion.

This soil is irrigated and used for crops. When this soil dries, it shrinks and deep cracks form. When it is irrigated and becomes wet, it swells and the cracks close. This shrinking and swelling damages the roots of alfalfa and reduces growth. Capability unit IIs-4 (irrigated).

Maricopa Series

The Maricopa series consists of well-drained, nearly level soils that have a loam or sandy loam surface layer. These soils formed in mixed materials deposited on flood plains and alluvial fans by streams and washes. They are generally calcareous throughout the profile. Elevations range from 2,600 to 3,300 feet, and the average annual rainfall is about 9 inches. In areas not cultivated the vegetation is mainly creosotebush, mesquite, saltbush, willow, and annual grasses and weeds.

The surface layer ranges from pale-brown loam to brown sandy loam in texture and from 6 to 12 inches in thickness. Below this layer is a layer of pale-brown sandy loam that overlies brown gravelly sand or coarse sand at a depth of about 2 feet.

The Maricopa soils are near the Anthony, Agua, Gila, and Grabe soils.

Maricopa soils are used for irrigated crops, desert range, and water supply. Sorghum, alfalfa, cotton, small grains, and pasture plants are irrigated. The underlying sand and gravel can be used in engineering work.

Maricopa sandy loam (Mr).—This nearly level soil is on flood plains and alluvial fans of streams and washes in the inner valley. The surface layer is smooth to slightly undulating, and slopes generally are less than 1 percent.

Representative profile (450 feet south and 1,900 feet west of the northeast corner of section 7, T. 6 S., R. 25 E.):

Ap—0 to 12 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) when moist; massive; slightly hard, very friable, nonsticky and slightly plastic; few very fine and fine roots; common, very fine and fine, tubular and few, very fine, interstitial pores; 3 to 10 percent of volume is gravel; slightly effervescent; moderately alkaline (pH 8.0); clear, smooth boundary.

C1—12 to 26 inches, pale-brown (10YR 6/3) sandy loam, dark brown (10YR 4/3) when moist; massive; slightly hard, very friable, nonsticky and nonplastic; few very fine and fine roots; few, very fine and fine, tubular and interstitial pores; 0 to 5 percent of volume is gravel; slightly effervescent; moderately alkaline (pH 8.2); clear, smooth boundary.

IIC2—26 to 48 inches, brown (10YR 5/3) and varicolored stratified very gravelly sand, dark brown (10YR 4/3) when moist; single grain; loose when moist or dry, nonsticky and nonplastic; few very fine roots; common, fine and medium, interstitial pores; 40 to 60 percent of volume is gravel; slightly effervescent; moderately alkaline (pH 8.0).

Hues of the A and C horizons range from 7.5YR to 10YR. Values of the A and C1 horizons range from 5 to 7 when the soil is dry and from 3 to 5 when the soil is moist. Chromas of the A horizon are 3 or 4 when the soil is moist. The texture of the A horizon generally is sandy loam, but this layer contains strata that range from fine sandy loam to loamy fine sand. The IIC2 horizon ranges from fine sand to very gravelly sand. Depth to the IIC2 horizon commonly is about 24 to 26 inches, but it ranges from 20 to 36 inches.

Included with this soil were small areas of Anthony, Brazito, and Arizo soils.

Permeability of this soil is moderately rapid to a depth of about 2 feet; below this depth it is very rapid. Runoff is slow. The available moisture holding capacity is low. Roots generally penetrate to a depth of 24 to 35 inches, but the roots of alfalfa and other deep-rooted crops go deeper. There is little or no hazard of soil blowing or water erosion.

Grasses, small grains, and alfalfa are the chief crops grown on this soil. It is not well suited to cotton and other row crops, but is better suited to grasses and legumes. Other uses are for desert range, wildlife, and water supply. Capability unit IIIs–2 (irrigated), VIIs–1 (dryland).

Maricopa loam (Mo).—Except for having a loam surface layer, this soil is similar to the nearby Maricopa sandy loam. Slopes range from 0 to 2 percent but generally are less than 1 percent. The surface layer ranges from 7 to 14 inches in thickness.

Included with this soil were small areas that have a surface layer ranging from very fine sandy loam to clay loam.

The available moisture holding capacity is fair, and natural fertility is low to medium. There is little or no hazard of soil blowing or water erosion.

This soil is used mainly for irrigated alfalfa, small grains, sorghum, pasture grasses, and cotton. It is better suited to shallow rooted crops or alfalfa than it is to cotton or other row crops. Unirrigated areas are used for desert range, wildlife, or water supply. Capability unit IIs–5 (irrigated), VIIs–1 (dryland).

Pima Series

The Pima series consists of deep, well-drained, nearly level soils that have a clay, clay loam, or loam surface layer. These soils formed in mixed materials that were deposited on flood plains and alluvial fans throughout the inner valley. Elevations range from 2,600 to 3,100 feet, and the average annual rainfall is about 9 inches. In areas not cultivated the vegetation is mesquite, saltbush, saltcedar, and annual grasses and weeds.

The surface layer ranges from grayish-brown clay to loam in texture and commonly from 9 to 18 inches in thickness. Below this layer is a layer of pale-brown to brown clay loam. Loam or very fine sandy loam occurs below a depth of 2 or 3 feet in some places.

Pima soils are irrigated and used for cotton, sorghum, barley, pasture grasses, and other crops suited to the survey area. Unirrigated areas are used for desert range, wildlife, and water supply.

Pima clay loam (Pc).—This nearly level soil is in fields in the inner valley. Slopes generally are less than 0.5 percent.

Representative profile (1,000 feet south and 1,320 feet east of the northwest corner of section 34, T. 6 S., R. 25 E.):

Ap1—0 to 12 inches, grayish-brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, granular structure; hard, firm, sticky and plastic; plentiful roots; many very fine and common medium pores; strongly effervescent; moderately alkaline (pH 8.0); clear, smooth boundary.

Ap2—12 to 18 inches, grayish-brown (10YR 5/2) and brown (10YR 5/3) clay loam, very dark grayish brown (10YR 3/2) when moist; massive; very hard, firm, sticky and plastic; plentiful roots; numerous very fine and common medium pores; strongly effervescent; moderately alkaline (pH 8.2); clear, smooth boundary.

C1—18 to 42 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) when moist; massive; very hard, firm, sticky and plastic; plentiful roots; worm casts below a depth of 18 inches; common gypsum mycelia and an occasional lime spot below a depth of 18 inches; strongly effervescent; moderately alkaline (pH 8.2); clear, smooth boundary.

C2—42 to 60 inches, pale-brown (10YR 6/3) clay loam, dark brown (10YR 4/3) when moist; massive; very hard, firm, sticky and plastic; plentiful roots; violently effervescent; moderately alkaline (pH 8.2).

Hues of the A and C horizons range from 7.5YR to 10YR. Values of the A horizons are less than 5.5 when the soil is dry and less than 3.5 when the soil is moist. Values of the C horizons generally range from 4 to 6 when the soil is dry and from 2 to 5 when it is moist. The texture of the Ap1 horizon generally is clay loam, but it ranges to silty clay loam. The Ap2 and the C1 horizons are stratified clay loam, silty clay loam, and silt loam. Material below the C1 horizon is stratified and ranges from loam, silt loam, clay loam, and in places, sandy loam to homogeneous clay loam or clay.

Included with this soil were small areas of Grabe, Gila, and Comoro soils.

Permeability of this soil is moderately slow, and runoff is medium to slow. The available moisture holding capacity is good. Roots penetrate below a depth of 60 inches. The organic-matter content is moderately low, and natural fertility is high. There is little or no hazard of soil blowing or water erosion.

This soil is suited to all irrigated crops adapted to the survey area. The main crops grown are cotton, sorghum, barley, alfalfa, and pasture grasses. Capability unit I–2 (irrigated).

Pima clay (Pa).—Except for having a clay surface layer, this soil is similar to the nearby Pima clay loam. The surface layer ranges from 10 to 16 inches in thickness. In some places loam or very fine sandy loam is below a depth of 2 feet. This soil cracks when it dries, but the cracks close when the soil is wet by irrigation water. Slopes are generally less than 0.5 percent.

Included with this soil in mapping were small areas that have a clay loam surface layer.

This Pima soil is used for adapted irrigated crops, chiefly cotton, small grains, and pasture grasses. Capability unit IIs–4 (irrigated).

Pima clay loam, saline (Pe).—Except for containing salts throughout the profile, this soil is similar to the nearby Pima clay loam. This nearly level soil contains enough salts to restrict germination and growth of most plants. The available moisture holding capacity is good, and erosion is a slight or moderate hazard. Slopes are generally less than 0.5 percent.

This Pima soil is suited to irrigated barley, pasture grasses, or other crops that tolerate salt. Capability unit IIs–2 (irrigated).

Pima loam (Pm).—Except for having a loamy surface layer, this soil is similar to Pima clay loam. It occurs only on the flood plains of tributaries of the Gila River south of Safford. This soil formed in material that was deposited in shallow water and that was somewhat poorly drained. The surface layer is smooth to slightly undulating, and slopes generally are less than 1 percent. The surface layer ranges from 9 to 14 inches in thickness. Permeability is moderately slow. The organic-matter content is moderate to moderately high, and natural fertility is medium to high. There is little hazard of soil blowing, but irrigation water moves some soil material to lower areas in the field.

Included with this soil were small areas that have sandy loam underlying material.

This soil is used for most adapted irrigated crops, desert range, wildlife, and water supply. In areas not cultivated the vegetation consists of mesquite, saltbush, pickleweed, and annual grasses and weeds that provide a moderate amount of grazing for cattle and wildlife. Capability unit IIs–7 (irrigated), VIIs–1 (dryland).

Pinaleno Series

The Pinaleno series consists of deep, well-drained, nearly level to moderately sloping soils that have a gravelly loam, gravelly sandy loam, or cobbly loam surface layer. A gravelly or cobbly, weakly cemented layer of lime occurs below a depth of 2 or 3 feet. These soils are on terraces throughout the inner valley. Elevations range from 2,800 to 3,400 feet, and the average annual rainfall is about 9 inches. The vegetation consists chiefly of creosotebush, cholla, and annual weeds and grasses, but in some areas it is mostly wolfberry, whitethorn, catclaw, mesquite, and annual plants.

The surface layer is brown or reddish-brown gravelly loam, cobbly loam, or gravelly sandy loam and ranges from 1 to 10 inches in thickness. The subsoil is reddish-brown and yellowish-red gravelly loam or very gravelly clay loam that extends to a depth of 2 to 4 feet. The substratum is a very gravelly and cobbly, weakly cemented layer of accumulated lime that ranges from 6 to 24 inches in thickness.

The Pinaleno soils are not cultivated. They are used for desert range, wildlife, and water supply.

Pinaleno gravelly loam, 0 to 5 percent slopes (PrB).—This soil is on terraces above the inner valley.

Representative profile (2,100 feet north and 150 feet west of the southeast corner of section 20, T. 7 S., R. 27 E.):

A1—0 to 1½ inches, brown (7.5YR 5/4) gravelly loam, dark brown (7.5YR 4/4) when moist; weak, medium, platy structure that breaks to moderate, fine, granular; soft, very friable, nonsticky and nonplastic; few very fine roots; common, very fine, interstitial and few, very fine, tubular pores; mildly alkaline (pH 7.5); abrupt, smooth boundary.

B1—1½ to 9 inches, reddish-brown (5YR 5/4) gravelly loam, reddish brown (5YR 4/4) when moist; weak, fine, subangular blocky structure that breaks to moderate, fine and medium, granular; slightly hard, very friable, slightly sticky and slightly plastic; few or abundant very fine roots; common, very fine, interstitial and common, very fine, tubular pores; moderately alkaline (pH 8.0); clear, smooth boundary.

IIB21t—9 to 14 inches, reddish-brown (5YR 4/4) very gravelly clay loam, dark reddish brown (5YR 3/4) when moist; moderate, fine, subangular blocky structure; slightly hard, very friable, sticky and plastic; abundant very fine roots; few, very fine, interstitial and common, very fine, tubular pores; few thin patchy clay films; slightly effervescent; moderately alkaline (pH 8.0); clear, wavy boundary.

IIB22t—14 to 30 inches, yellowish-red (5YR 5/6) very gravelly clay loam, yellowish red (5YR 4/6) when moist; common, fine, distinct mottles of white (N 8/0) lime, pinkish white (5YR 8/2) when moist; moderate, fine, subangular blocky structure; slightly hard, friable, sticky and plastic; plentiful very fine roots; few, very fine, tubular pores; thin patchy clay films; strongly effervescent; moderately alkaline (pH 8.0); abrupt, wavy boundary.

IIICca—30 to 45 inches, white (N 8/0) and pinkish-white (5YR 8/2) very gravelly and cobbly, weakly cemented layer of accumulated lime, pink (7.5YR 7/4) when moist; massive; very hard, very firm; violently effervescent; moderately alkaline (pH 8.0).

Texture of the A1 and B1 horizons ranges from gravelly loam to very gravelly loam. In some places the pebbles are coated with desert varnish. Hues of the A1 horizon range from 5YR to 10YR. Values range from 4 to 6 when the soil is dry and from 3 to 5 when the soil is moist. Chromas are 4 or less. Texture of the IIB21t and IIB22t horizons ranges from very gravelly loam to very gravelly clay loam, and the volume of gravel ranges from 40 to 80 percent. Hues of these horizons range from 5YR to 7.5YR. Values are 4 or 5 when the soil is dry and 3 or 4 when the soil is moist. Chromas range from 4 to 6. The layer of accumulated lime is weakly cemented and is gravelly or very gravelly and cobbly.

Permeability of this soil is moderate to moderately slow above the cemented layer and is very slow in that layer. The available moisture holding capacity is low to fair. Roots penetrate to a depth of 24 to 36 inches. The organic-matter content is low, and natural fertility is medium. There is little or no hazard of soil blowing or water erosion, if some plant cover is maintained.

This soil is used for desert range, wildlife, and water supply, for which it is suited. In favorable years seedings of Lehmann lovegrass or other drought-resistant grass are successful. Capability unit VIIs-4 (dryland).

Pinaleno cobbly loam, 2 to 5 percent slopes (PnB).—This soil is on the lower terraces above the inner valley north of the Gila River. Except that more than 10 percent of the surface is covered with cobblestones, this soil is similar to Pinaleno gravelly loam, 0 to 5 percent slopes. The surface layer is 5 to 8 inches thick and overlies very gravelly clay loam. A weakly cemented layer of accumulated lime is at a depth of about 3 to 4 feet.

This soil is used for desert range, wildlife, and water supply. In favorable years seedings of Lehmann lovegrass or other drought-resistant grass are successful. Capability unit VIIs-4 (dryland).

Pinaleno-Bitter Spring complex, 0 to 5 percent slopes (PsB).—About 55 to 60 percent of this complex is Pinaleno soil; 30 to 35 percent, Bitter Spring soil; and 5 to 15 percent, included soils.

The Pinaleno soil is similar to Pinaleno gravelly loam, 0 to 5 percent slopes. A representative profile for a Bitter Spring soil is described under the Bitter Spring series.

The Pinaleno soil is on terraces above the inner valley. The Bitter Spring soil is on the sides and eroded edges of the ridges of terraces above the inner valley. Included with this complex were small areas of Anthony and Arizo soils.

The soils of this complex are used for desert range, wildlife, and water supply. The natural vegetation provides some grazing. It consists mainly of creosotebush, cholla, and annual grasses and weeds, but mesquite, catclaw, whitethorn, and wolfberry grow along the washes. Capability unit VIIs-4 (dryland).

Pinaleno-Cave complex, 0 to 5 percent slopes (PuB).—About 55 to 60 percent of this complex is Pinaleno soil; 30 to 35 percent, Cave soil; and 5 to 15 percent, included soils. The Pinaleno soil is similar to Pinaleno gravelly loam, 0 to 5 percent slopes. A representative profile for a Cave soil is described under the Cave series. A few washes have cut canyons across the terraces.

The Pinaleno soil is on smooth terraces and alluvial fans of terraces above the inner valley. The Cave soil is along the edges and low ridges of the terraces. Included with this complex were small areas of Arizo and Bitter Spring soils and of Rough broken land. Also included were small areas of gravelly calcareous soils.

The soils of this complex are used for desert range, wildlife, and water supply. The natural vegetation provides some grazing. It consists mainly of creosotebush, cholla, and annual grasses and weeds, but there is some wolfberry and mesquite. Capability unit VIIs-4 (dryland).

Pinaleno-Continental gravelly sandy loams, 0 to 10 percent slopes (PvC).—About 50 to 55 percent of this complex is Pinaleno soil; 30 to 35 percent, Continental soil; and 10 to 20 percent, included soils. The Pinaleno soil is similar to Pinaleno gravelly loam, 0 to 5 percent slopes, but it has a gravelly sandy loam surface layer. A representative profile of a Continental soil is described under the Continental series.

The Pinaleno soil is on low terraces and old alluvial fans of terraces above the inner valley. The Continental soil is on smooth terraces above the inner valley. Included with this complex were areas of Arizo, Cave, and Anthony soils and of Rough broken land.

The soils of this complex are used for desert range, wildlife, and water supply. The native vegetation provides some grazing. It consists mainly of creosotebush, wolfberry, whitethorn, catclaw, cholla, and annual weeds and grasses, but mesquite and paloverde grow in the washes. On high mesas the vegetation is chiefly curly mesquite, tobosa, ocotillo, snakeweed, and creosotebush, but there are a few junipers. Capability unit VIIs-4 (dryland).

Riverwash

Riverwash (Rh) consists of intermingled areas of stratified and interbedded soil material that ranges from gravelly silt loam to cobbly sand in texture. These areas are in the channel and on adjacent flood plains of the Gila River and its tributaries. Slopes range from 0 to 3 percent. Elevations range from 2,600 to 3,300 feet, and the average annual rainfall is 9 to 11 inches. Areas of Riverwash are flooded frequently and are subject to deposition and erosion. Mesquite, saltcedar, and annual weeds grow in some places, but vegetation is sparse. Roots can penetrate to a depth of 60 inches or more. Permeability is rapid, and natural fertility is low.

Riverwash can be used for water supply and wildlife. In some places sand and gravel can be mined for use in engineering works. Capability unit VIIIw-1 (dryland).

Rock Land

Rock land (Rk) consists of very shallow, slightly eroded soils on hillsides that have many rock outcrops. Slopes range from 5 to 50 percent. Areas of Rock land occur in the Black Hills north of Fort Thomas. About 60 to 70 percent of mapped areas is rock outcrop, and the rest consists of shallow soils. The soils are mainly very shallow, stony or very gravelly, and loamy, but on hilltops they are shallow, gravelly, and fine textured. Elevations range from 3,100 to 3,700 feet, and the average annual rainfall is about 9 inches. The vegetation is mainly creosotebush, coffeeberry, ocotillo, giant saguaro, cholla, and annual grasses and weeds. Tobosa, paloverde, Mormontea, and snakeweed grow on the tops of hills. Plants grow in the cracks of rock outcrops and on the thin soils, but only lichen grows on the rocks.

Rock land can be used for water supply and wildlife. The vegetation provides limited grazing for cattle. Capability unit VIIs-8 (dryland).

Rough Broken Land

Rough broken land (Ro) consists of terrace breaks caused by drainage channels of intermittent streams that have

cut into the underlying basin fill: of short alluvial fans; of rounded, knobby hills; and of remnants of severely eroded terraces that have steep side slopes. Slopes generally are more than 10 percent, and in most places they range from 30 to 60 percent. Elevations range from 2,700 to 4,500 feet, and the average annual rainfall is 9 to 11 inches. The hazard of erosion is slight to moderate. Permeability is moderate to rapid, and natural fertility is low. The kind and amount of vegetation vary with steepness, soil material, direction of exposure, and degree of erosion. The vegetation consists of creosotebush, saltbush, whitethorn, snakeweed, mesquite, tobosa, fluffgrass, three-awn, side-oats grama, ocotillo, pricklypear, barrel cactus, and yucca. The more severely eroded areas generally are barren. Roots penetrate to depths ranging from 12 inches to more than 60 inches.

Rough broken land is used mainly for wildlife and water supply, for which it is suited, but some areas are used for grazing cattle. Capability unit VIIIs–1 (dryland).

Tidwell Series

The Tidwell series consists of well-drained, nearly level to gently sloping, calcareous soils that have a sandy loam surface layer. These soils are shallow and very shallow and overlie poorly consolidated, interbedded calcareous sandstone and shale. They formed in material weathered from rock on low hills that are a part of the low terraces above the inner valley. Elevations range from 2,600 to 3,300 feet, and the average annual rainfall is about 9 inches. In areas not cultivated the chief vegetation is creosotebush, saltbush, and annual grasses and weeds.

The surface layer is light brownish-gray sandy loam or loam about 10 inches thick. Below this layer is brown sandy loam or loam. Depth to sandstone and shale ranges from 6 to 24 inches.

Tidwell soils are used for irrigated cotton, small grains, alfalfa, and pasture plants. Unirrigated areas are used for desert range, wildlife, and water supply. These soils are of limited acreage in the survey area and are not important for growing crops.

Tidwell sandy loam, 0 to 2 percent slopes (TeA).—This soil is on low hilltops and in swales of the lower terraces. The surface is smooth, and slopes generally are less than 1 percent.

Representative profile (1,225 feet south and 850 feet west of the east quarter corner of section 7, T. 8 S., R. 26 E.):

Ap—0 to 10 inches, light brownish-gray (10YR 6/2) sandy loam, dark brown (10YR 4/3) when moist; massive; slightly hard, friable, nonsticky and nonplastic; plentiful fine and few medium roots; few, very fine, tubular and few, very fine, interstitial pores; few fine fragments of sandstone; strongly effervescent; strongly alkaline (pH 8.5); abrupt, smooth boundary.

C—10 to 16 inches, brown (10YR 5/3) sandy loam or loam, dark brown (10YR 4/3) when moist; massive; hard, friable, slightly sticky and slightly plastic; few fine and medium roots; common, very fine and few, fine, tubular pores; few to common fine and medium fragments of sandstone; strongly effervescent; moderately alkaline (pH 8.2); gradual, wavy boundary.

R—16 to 50 inches, interbedded light-gray (10YR 7/1) calcareous sandstone and pinkish-gray (7.5YR 7/2) calcareous clay shale, pale brown (10YR 6/3) and brown (7.5YR 5/2) when moist; massive with thick platy layers; roots form a mat on top of this layer and penetrate a few cracks; strongly effervescent; strongly alkaline (pH 8.5).

Hues of the A and C horizons range from 7.5YR to 10YR. Values range from 5 to 7 when the soil is dry and from 4 to 6 when the soil is moist. Texture of the A and C horizons ranges from sandy loam to loam. Thickness of the A horizon ranges from 4 to 12 inches, and that of the C horizon from 3 to 8 inches. Depth to the R horizon generally is between 12 and 20 inches, but it ranges from 6 to 24 inches.

Included with this soil in mapping were small areas of Gila, Glendale, and Anthony soils.

Permeability of this soil is moderately rapid to moderate, and runoff is medium. The available moisture holding capacity is very low. Roots penetrate to a depth of 6 to 24 inches. The organic-matter content and natural fertility are low. There is little or no hazard of soil blowing or water erosion, if plant cover is maintained.

This soil is used for irrigated cotton, small grains, pasture plants, and truck crops, but pasture plants and truck crops are better suited. Unirrigated areas are used for desert range, wildlife, and water supply. Capability unit IVs–2 (irrigated), VIIs–8 (dryland).

Tidwell extremely rocky sandy loam, 0 to 5 percent slopes (TdB).—This soil is on low hills and ridges that are remnants of old lacustrine deposits. About 40 to 45 percent of this mapping unit consists of outcrops of sandstone and shale. These outcrops are on hilltops and side slopes and are so intermingled with areas of soil that separating them on a soil map is not practical. The soil between the outcrops is similar to Tidwell sandy loam, 0 to 2 percent slopes.

This soil is used only for desert range, wildlife, and water supply. The vegetation consists mainly of creosotebush, saltbush, and a few annual weeds and grasses. Capability unit VIIs–8 (dryland).

Tidwell, Gila and Glendale soils, saline, 0 to 2 percent slopes (TgA).—The main soils in this undifferentiated group are Tidwell sandy loam; Gila loam, saline; Glendale silt loam, saline-alkali; and Glendale silty clay loam, saline. The areas of these soils are so intermingled from place to place that the percentage of each cannot be computed accurately. This mapping unit is on narrow to broad alluvial plains resulting from low, eroding hills and on remnants of eroded hills. A representative profile of a Tidwell, Gila, and Glendale soil is described under those respective series. Erosion is slight to moderate, and a few shallow gullies occur. Included with this unit in mapping were small areas of Brazito and Anthony soils.

The soils of this unit are used only for desert range, wildlife, and water supply. The content of soluble salts limits the vegetation mostly to saltbush and suaeda, but some mesquite, cholla, and pricklypear grow. Capability unit VIIs–8 (dryland).

Tres Hermanos Series

The Tres Hermanos series consists of deep, well-drained, nearly level to sloping, calcareous soils that have a gravelly sandy loam surface layer. These soils formed in very strongly calcareous, mixed materials deposited

on the lower terraces above the inner valley. Elevations range from 2,700 to 3,200 feet, and the average annual rainfall is about 9 inches. The vegetation is mainly creosotebush, saltbush, yucca, cactus, and a few annual weeds and grasses, but some areas are barren.

The surface layer is pink gravelly sandy loam about 2 inches thick. The subsoil is brown sandy clay loam that extends to a depth of about 12 inches. The substratum is light-brown, calcareous gravelly sandy loam or gravelly loam and extends to a depth of 5 feet or more. In places a thin cemented layer of accumulated lime is below a depth of 18 to 24 inches.

The Tres Hermanos soils are used for desert range, wildlife, and water supply. In the Safford Area, Tres Hermanos soils are mapped only in a complex with the Bitter Spring soils.

Tres Hermanos-Bitter Spring gravelly sandy loams, 0 to 10 percent slopes (ThC).—The Tres Hermanos soil in this complex is on flats and in depressions of the lower terraces above the inner valley. Slopes of this soil are generally less than 2 percent, but in some places they are as much as 5 percent. The Bitter Spring soil is on low hills and ridges that are remnants of terraces. Slopes of this soil generally are 2 to 5 percent, but in places they are as much as 10 percent.

About 45 to 50 percent of this complex is Tres Hermanos soil; 35 to 40 percent, Bitter Spring soil; and 10 to 20 percent, included soils. A representative profile of a Bitter Spring soil is described for the Bitter Spring series.

Representative profile of a Tres Hermanos gravelly sandy loam (2,500 feet north and 300 feet east of the south quarter corner of section 30, T. 6 S., R. 26 E.):

A1—0 to 2 inches, pink (7.5YR 7/4) gravelly sandy loam, brown (7.5YR 5/4) when moist; weak, medium, platy structure; slightly hard, friable, nonsticky and slightly plastic; common, fine and medium, vesicular pores; few, fine, interstitial and few, very fine, tubular pores; strongly effervescent; moderately alkaline (pH 8.0); abrupt, smooth boundary.

B2t—2 to 6 inches, brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 4/4) when moist; few, fine, pink (7.5YR 8/4) mottles; moderate, fine, subangular blocky structure; hard, friable, slightly sticky and plastic; few fine roots; few, very fine and medium, tubular and common, interstitial pores; thin clay films in pores; violently effervescent; moderately alkaline (pH 8.0); abrupt, smooth boundary.

B3ca—6 to 11 inches, brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 4/4) when moist; many, fine and medium, faint mottles of pink (7.5YR 8/4); massive; hard, friable, sticky and plastic; very few fine roots; few, very fine, tubular and few, fine, interstitial pores; violently effervescent; moderately alkaline (pH 8.0); gradual, wavy boundary.

IICca—11 to 55 inches, light-brown (7.5YR 6/4) gravelly sandy loam, brown (7.5YR 5/4) when moist; many, medium and coarse, distinct mottles of white (N 8/0); massive; hard, friable to firm, slightly sticky and plastic; few, fine, tubular pores; violently effervescent; moderately alkaline (pH 8.0).

The surface of much of this Tres Hermanos soil has an erosion pavement, and many of the pebbles are coated with desert varnish. In some small areas basin fill is exposed. Hues of the A and B horizons range from 5YR to 7.5YR. Values of the A horizon range from 5 to 7 when the soil is dry and from 3 to 5 when it is moist. Chromas are 4 or less. Values of the B horizon range from 4 to 5 when the soil is dry and from 3 to 4 when it is moist. The A horizon ranges from loam to gravelly sandy loam in texture and from 2 to 6 inches in thickness. The sandy clay loam B horizons range from 1 to 16 inches in thickness. The volume of gravel in the soil profile ranges from less than 10 percent to about 40 percent and generally increases with depth. Cementation in the IICca horizon ranges from weak to strong.

Included with this complex in mapping were areas of Anthony and Cave soils and areas of Rough broken land.

Permeability of the Tres Hermanos soil is moderately slow in the upper 12 inches but is moderately rapid below this depth. Runoff is medium to rapid. The available moisture holding capacity is fair. Roots penetrate to a depth of 12 to 36 inches. The organic-matter content is very low, and natural fertility is low. There is little or no hazard of soil blowing or water erosion if plant cover is maintained.

The soils of this complex are used for desert range, wildlife, and water supply. The vegetation is mainly creosotebush, saltbush, yucca, cactus, and a few annual grasses and weeds, but some small areas are barren. Capability unit VIIs-7 (dryland).

Whitlock Series

The Whitlock series consists of well-drained, nearly level to gently sloping, calcareous soils that have a loam or sandy loam surface layer. These soils formed in mixed calcareous material deposited on alluvial fans that extend from the lower terraces above the inner valley. They occur only in an area south of Pima. Elevations range from 2,800 to 3,000 feet, and the average annual rainfall is about 9 inches. In areas not cultivated, the vegetation is mainly creosotebush, saltbush, and annual grasses and weeds.

The surface layer ranges from loam to sandy loam in texture and from 6 to 16 inches in thickness. Below the surface layer is a layer of pink sandy loam. Below a depth of 2 or 3 feet the soil material ranges from sand to loam in texture.

Whitlock soils are used for irrigated cotton, alfalfa, and pasture grasses. Unirrigated areas are used for desert range, wildlife, and water supply.

Whitlock sandy loam, 0 to 2 percent slopes (WkA).—This soil is on the lower terraces and alluvial fans adjacent to the inner valley. The surface is smooth to slightly undulating, and slopes generally are less than 1 percent.

Prepresentative profile (1,000 feet east and 100 feet north of the southwest corner of section 30, T. 6 S., R. 25 E.):

Ap—0 to 12 inches, light-brown (7.5YR 6/4) sandy loam, dark brown (7.5YR 4/4) when moist; massive; hard, friable, slightly sticky and slightly plastic; few medium and plentiful fine roots; common interstitial pores; few to common fine nodules of lime; violently effervescent; moderately alkaline (pH 8.0); abrupt, wavy boundary.

C1ca—12 to 29 inches, pink (7.5YR 7/4) sandy loam, light brown (7.5YR 6/4) when moist; many, medium and coarse, distinct mottles of white (N 8/0); massive; hard, friable, slightly sticky and plastic; few medium and plentiful fine roots; common, very fine and fine pores and few, medium, tubular pores; many medium and large nodules and splotches of lime; violently effervescent; moderately alkaline (pH 8.0); clear, wavy boundary.

IIC2—29 to 54 inches, light-brown (7.5YR 6/4) sand, dark brown (7.5YR 4/4) when moist; massive; slightly hard, very friable, nonsticky and nonplastic; few medium and plentiful fine roots; common, very fine, interstitial pores; few medium segregations and splotches of lime; violently effervescent; moderately alkaline (pH 8.0).

The A and C horizons have a hue of 7.5YR. Values of the A horizon are greater than 5.5 when the soil is dry and greater than 3.5 when the soil is moist. Chromas range from 2 to 4. Texture of the A horizon generally is sandy loam, but in some areas it is loamy sand. Thickness of this horizon ranges from 8 to 12 inches. Lime nodules in the A horizon range from none to many. Texture of the C1ca horizon ranges from loam to coarse sandy loam. Lime nodules in this horizon range from few to many and from medium to large. Depth to the IIC2 horizon ranges from 25 to 56 inches. The volume of gravel in the surface layer is less than 10 percent in most places, but in some it is as much as 35 percent.

Included with this soil in mapping were small areas of Anthony and Brazito soils.

Permeability of this soil is moderately rapid, and runoff is medium to slow. The available moisture holding capacity is fair. Roots penetrate to a depth of 60 inches or more. The organic-matter content and natural fertility are low. There is little or no hazard of water erosion or soil blowing if some plant cover is maintained.

This soil is used for cultivated crops, desert range, wildlife, and water supply. Because of the high content of lime, some plants cannot be grown, but alfalfa and other plants that tolerate a high lime content are suitable. Capability unit IIIs-1 (irrigated), VIIs-7 (dryland).

Whitlock loam, 0 to 2 percent slopes (WhA).—Except for having a loam textured surface layer, this soil is similar to Whitlock sandy loam, 0 to 2 percent slopes. The texture of the surface layer is mainly loam, but in some irrigated fields it is clay loam. The organic-matter content is moderately low, and natural fertility is medium. There is little or no hazard of soil blowing or water erosion.

This soil can be used for most irrigated crops, but unirrigated areas produce little range forage. Barley, sorghum, and other shallow-rooted plants can be grown on this soil, as well as alfalfa, cotton, and pasture grasses. Capability unit IIIs-1 (irrigated), VIIs-7 (dryland).

Whitlock sandy loam, 2 to 5 percent slopes (WkB).—This soil is gently sloping but is otherwise similar to Whitlock sandy loam, 0 to 2 percent slopes. The surface is undulating. This soil occurs on the lower terraces and breaks above the inner valley. It is susceptible to moderate soil blowing and water erosion.

Included with this soil in mapping were areas that have slopes of as much as 10 percent.

This soil is used for desert range, wildlife, and water supply. Water is not available for irrigation, and few forage plants grow in unirrigated areas. Some seasonal grazing is provided by saltbush and by annual grasses and weeds. Capability unit VIIe-1 (dryland).

Use and Management of the Soils

The first part of this section discusses the management of irrigated soils. In the second part, the capability classification system used by the Soil Conservation Service is explained, the capability units in the Safford Area are briefly described, and some suggestions for use and management are given. These are followed by a table of estimated yields, a discussion of irrigation water, and engineering uses of soils.

Management of Irrigated Soils [2]

Proper use and management of the irrigated soils of the Safford Area depend primarily on (1) the choice of cropping systems, (2) periodic addition of organic matter, (3) fertilization, (4) water management, and (5) land leveling.

Conservation cropping systems

A conservation cropping system is a combination of practices that maintain crop growth and that improve the fertility and tilth of the soil. This system includes a crop rotation, but the use of green-manure crops, crop residue, fertilization, land leveling, good methods of tillage, and other supporting practices are needed.

Addition of organic matter

Because of high temperatures, low humidity, and tillage, the organic matter in soils decomposes almost as fast as it is replaced. Organic matter can be replaced by (1) plowing under crop residue and green-manure crops, (2) growing grasses and legumes in the rotation, and (3) adding barnyard manure. Only a few soils in the survey area, such as Pima and Guest, have as much as 2 percent organic matter, and some, such as Whitlock and Arizo, have less than one-half percent.

Fertilization

Nitrogen and phosphorus are the main plant nutrients that are low in soils of the survey area. In general, the supply of potassium and less important elements, such as iron, calcium, and magnesium, is adequate. In the Whitlock soils, calcium carbonate (lime) is so abundant that it interferes with the absorption of iron and zinc by some crops. Field trials and the results of soil tests by a qualified soils laboratory can be used to indicate the kind and amount of fertilizer needed.

Water management

Management of irrigation water is the one major farm practice in the survey area upon which all other practices depend. Water is supplied from the Gila River and from deep wells. The amount of water supplied by the river depends on the amount of runoff from snowmelt in the mountains and from rainfall. The water is delivered to individual farms through canals on rotation and not on demand. Improvement in the method of delivery would improve agriculture in the survey area. In some places farmers use water from wells to supplement water from the river because that supply is variable. The quantity and quality of water from wells also is variable.

Flat fields can be irrigated by flooding and provide the best possible control of irrigation water (fig. 4). Guest, Pima, and Glendale soils can be leveled flat. A

[2] Prepared by THOMAS W. TURNER, work unit conservationist, Soil Conservation Service.

method of applying irrigation water to sloping soils is by sprinkling. The Anthony, Brazito, and Comoro sandy loams can be irrigated effectively by sprinkling.

Leveling

Many soils in the Safford Area, though fairly level, have enough side slope to make efficient use of irrigation water difficult. These soils should be leveled to designed grade, as nearly flat as practicable, with no side slope (fig. 5).

In general, the soils in the survey area can be leveled with little or no damage to the soils. Field investigations are needed, however, to determine the depth of cuts allowable in the Agua, Brazito, Arizo, Maricopa, and other soils where sand and gravel occur below a depth of a foot.

Capability Groups of Soils

Capability classification is the grouping of soils to show, in a general way, their suitability for most kinds of farming. It is a practical classification based on limi-

***Figure 4.*—A leveled field of Gila and Grabe soils flooded with irrigation water. Barley has been seeded in disked cotton stubble.**

***Figure 5.*—Leveling a field of Grabe soils to provide better management of irrigation water.**

tations of the soils, the risk of damage when they are used, and the way they respond to treatment. The classification does not apply to rice and other crops having special requirements. The soils are classified according to degree and kind of permanent limitation, but without consideration of major and generally expensive reshaping that would change the slope, depth, or other characteristics of the soils; and without consideration of possible but unlikely major reclamation projects.

In the capability system, all kinds of soils are grouped at three levels, the capability class, subclass, and unit. These are discussed in the following paragraphs.

Capability Classes, the broadest grouping, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. Classes are defined as follows:

- Class I. Soils have few limitations that restrict their use.
- Class II. Soils have some limitations that reduce the choice of plants or require moderate conservation practices.
- Class III. Soils have severe limitations that reduce the choice of plants, that require special conservation practices, or that require both.
- Class IV. Soils have very severe limitations that restrict the choice of plants, that require very careful management, or that require both.
- Class V. Soils subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife food and cover. (None in the Safford Area.)
- Class VI. Soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife food and cover. (None in the Safford Area.)
- Class VII. Soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to grazing, woodland, or wildlife.
- Class VIII. Soils and landforms have limitations that preclude their use for commercial plant production and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes.

Capability Subclasses are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c* shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V (none in the Safford Area) can contain, at the most, only subclasses indicated by *w*, *s*, and *c*, because the soils in it are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife, or recreation.

Capability Units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIs-1 or VIIe-1. Thus, in one symbol, the Roman numeral designates the capability class or degree of limitation, and the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph. The Arabic numeral specifically identifies the capability unit within each class and subclass.

In the following pages, the capability units in the Safford Area are described and suggestions for the use and management of the soils are given.

Management by capability units [3]

In this subsection the irrigated and dryland capability units in the Safford Area are described and some suggestions for use and management of the soils in each group are given. A capability unit is a group of soils about alike in those properties that affect management and that have similar response to management. All the soils in one capability unit have about the same limitation and about the same risk of damage. The soils in one unit, therefore, need about the same kind of management, though they may have formed from different kinds of parent material and in different ways.

The soils in all capability units in classes I through IV are irrigated and are used for crops and pasture. The units in capability classes VII and VIII are dryland capability units, and their soils are used mainly for desert range, wildlife habitat, and water supply. For the dryland units, important range plants growing on the soils are named. In the Safford Area, no soils were placed in capability units in classes V and VI.

The names of soil series represented are mentioned in the description of each capability unit, but this does not mean that all soils of a given series appear in that unit. To find the names of all soils in a given capability unit, refer to the "Guide to Mapping Units" at the back of this survey. The groupings of soils shown in this guide are subject to change as new methods are discovered or new information becomes available.

CAPABILITY UNIT I-1 (IRRIGATED)

This unit consists of deep, well-drained, nearly level soils in the Gila, Glendale, and Grabe series. These soils have a loam surface layer that overlies medium-textured or moderately fine textured material. They hold about 2 inches of available water per foot of soil depth, and their available moisture holding capacity is good. Permeability is moderate or moderately slow. The average annual precipitation is about 9 inches, but only 4 or 5 inches is available to plants. In some areas these soils overlie sand and gravel at a depth below 3 feet, and this material holds little available water. Runoff is slow, and erosion is not a hazard. Natural fertility is medium to high.

[3] Thomas W. Turner, work unit conservationist, Soil Conservation Service, assisted in writing this subsection.

The soils in this unit are productive and have few or no limitations to use. They are suited to cotton, alfalfa, small grains, sorghum, and other crops, and to pasture grasses. The organic-matter content and fertility can be maintained by following good management practices. Row crops can be used often in rotations if crop residue is left on the soil, if green-manure crops are turned under, and other supporting practices are used. Nitrogen is needed for most crops, especially where a legume is not included in the rotation, and phosphorus is needed for alfalfa and other legumes.

Leveling of these soils to a uniform grade is necessary for efficient use of irrigation water by gravity flow. Because some soils have sand and gravel below a depth of 3 feet, investigation of each field is needed to determine the depth to which cuts can be made. If sand and gravel are less than 3 feet below the surface after leveling, the modified soils will be in a different capability unit.

If tillage pans form, they can be broken up by subsoiling periodically. The formation of these pans can be controlled by growing grasses and legumes in the rotation, varying the depth of tillage, and working the soils within the correct range of moisture content.

CAPABILITY UNIT I-2 (IRRIGATED)

This unit consists of deep, well-drained, nearly level soils in the Grabe and Pima series. These soils have a clay loam surface layer that overlies medium-textured or moderately fine textured material. The surface layer holds moisture for long periods and cracks when it dries. These soils hold about 2 inches of available water per foot of soil depth, and their available moisture holding capacity is good. Permeability is moderate to moderately slow, and the water intake rate is slow to moderate. The average annual precipitation is about 9 inches. In some areas these soils overlie gravelly sand at a depth of 3 to 5 feet, and this material holds less than 1 inch of water per foot of depth. Runoff is slow, and soil blowing or water erosion is not a hazard. Natural fertility is high.

The soils in this unit are used for crops, and all crops adapted to the Safford Area can be grown. The main crops are cotton, sorghum, barley, grasses, and alfalfa. Cotton is commonly grown for 2 to 3 years, small grains for 1 year, and alfalfa for 2 or 3 years. More years of cotton can be grown and fewer years of alfalfa, grasses, green-manure crops, and other soil-improving crops, if the supporting practices maintain the organic-matter content and good soil tilth. The organic-matter content is fairly high for this survey area. Because the surface layer of these soils is clay loam, using green-manure crops and crop residue is needed to keep the content high. Fertilizer is needed to maintain good growth of most crops.

These soils should be leveled to a grade of less than 0.1 percent for efficient use of irrigation water by gravity flow. Where the underlying gravelly sand is 5 feet or more deep, these soils are not injured by leveling. If the gravelly sand is within 3 feet of the surface after leveling, the soil has been changed and is in a different capability unit.

These clayey soils should be worked only enough to prepare a seedbed. If they are worked when wet, a compacted layer forms and restricts the movement of water. If they are worked when too dry, they become soft and fluffy, and when water is applied, they run together and rate of water intake is reduced. Subsoiling periodically breaks up the compacted layer, and rough tillage helps to maintain good soil tilth.

CAPABILITY UNIT I-3 (IRRIGATED)

This unit consists of deep, well-drained, nearly level soils in the Gila series. These soils have a gravelly loam or sandy loam surface layer that overlies medium-textured material. The surface layer holds about 1.5 inches of available water per foot of soil depth and is moderately droughty. The underlying material holds about 2 inches of water per foot of soil depth. The available moisture holding capacity of these soils is good. The average annual precipitation is about 9 inches. Runoff is slow, and water erosion or soil blowing is not a hazard. Natural fertility is medium to high.

The soils in this unit allow satisfactory growth of all crops commonly grown in the survey area. The main crops are cotton, alfalfa, sorghum, small grains, and grasses. In some years and in some parts of the survey area, enough irrigation water is available to germinate a good stand of plants; and after the seedlings are established, all plants grow well. The rotation should contain alfalfa, grasses, or other soil-building crops at least 50 percent of the time. Organic matter can be added by using crop residue and green-manure crops. Additions of nitrogen are needed for most crops, and alfalfa is benefited by additions of phosphorus.

These soils should be leveled to a uniform grade of less than 0.3 percent for efficient use of irrigation water by gravity flow. Where leveling removes the present surface layer to a depth of 12 inches or more, the surface layer then will be finer textured and the modified soil will be in a different capability unit.

These soils have low organic-matter content, and good tilth is difficult to maintain. Tillage is not a problem, and the soils can be tilled through a wide range of moisture content without damage.

CAPABILITY UNIT IIs-1 (IRRIGATED)

This unit consists of deep, well-drained, saline soils in the Gila and Grabe series. These nearly level soils have a loam surface layer that overlies medium-textured material. Except for having soluble salts throughout their profile, the soils in this unit are similar to the soils in capability unit I-1 (irrigated). These saline soils have good available moisture holding capacity. Because the surface seals as a result of the high content of salts, the water intake rate is slow. The average annual precipitation is about 9 inches. Runoff is medium, and the hazard of erosion is slight.

The soils in this unit are not well suited to cultivated crops. Good tilth is difficult to maintain. Because of the high content of salts, germination of sorghum, barley, and alfalfa is reduced. This poor germination results in poor stands and lowered income.

These soils can be reclaimed temporarily by adding large amounts of organic matter, by growing salt-tolerant grasses to increase water penetration, and by deep leaching with irrigation water. Most of the salts can be re-

moved by leaching, but these measures must be used continually to maintain a low level of salts. After these soils have been reclaimed, they require about the same management as the soils in capability unit I–1 (irrigated).

CAPABILITY UNIT IIs–2 (IRRIGATED)

This unit consists of saline and saline and alkali soils in the Glendale and Pima series. These soils are deep, well drained, and nearly level. They have a silt loam, silty clay loam, or clay loam surface layer that overlies moderately fine textured material. These soils contain soluble salts and alkali throughout their profile that restrict germination and growth of most cultivated crops. They have good available moisture holding capacity. The surface seals readily because of the high content of salts, and the water intake rate is moderately slow to slow. The average annual precipitation is about 9 inches. Runoff is medium to rapid, and the hazard of erosion is slight to moderate.

Because of salts and alkali, the soils in this unit have some limitations to use for crops. The salts and alkali reduce germination of cotton, sorghum, barley, and alfalfa. This poor germination results in poor stands and lowered income.

Some of the excess salts can be removed from these soils by leaching with irrigation water. The soils should be leveled to a grade of less than 0.1 percent so that irrigation water can be ponded for leaching. This leveling will not cause permanent damage to the soils. Reclamation by leaching is difficult because of moderately slow permeability in the underlying material. Adding large amounts of organic matter and growing salt-tolerant grasses help to open the soils and make leaching more efficient. Suitable grasses are bermudagrass and tall wheatgrass. If the salts are removed, the modified soil will be in a different capability unit.

Minimum tillage should be used, as these soils seal readily when water is applied. Good tilth is difficult to maintain. Rough tillage helps to aerate the soils, improves the water intake rate, and improves tilth.

CAPABILITY UNIT IIs–3 (IRRIGATED)

This unit consists of deep, well-drained, nearly level soils in the Comoro and Anthony series. These soils have a loam or clay loam surface layer that overlies moderately coarse textured material. They are on flood plains and alluvial fans. The surface layer holds about 2 inches of available water per foot of soil depth, and the underlying material holds less than 1.5 inches. In some areas these soils overlie sand and gravel at a depth of 3 feet, and this material holds less than 1 inch of available water per foot of soil depth. The available moisture holding capacity is fair. Permeability is moderately rapid, and the water intake rate is moderate to slow. The average annual precipitation is about 9 inches. Runoff is very slow to medium, and erosion is not a problem. Natural fertility is low to medium.

The soils in this unit are suited to all crops commonly grown in the survey area. The main crops are cotton, alfalfa, sorghum, small grains, and grasses. Limitations to use are caused primarily by the moderately coarse textured underlying material. Turning under crop residue and growing green-manure crops are ways to add organic matter and to help maintain good tilth. Adding fertilizer helps to maintain or improve fertility. The number of years that row crops can be grown in the rotation depends on the supporting practices used.

Leveling to a uniform grade of not more than 0.2 percent is desirable for efficient use of irrigation water by gravity flow. In areas where sand and gravel or sandy loam material is within 3 feet of the surface after leveling, the modified soil will be in a different capability unit. Tillage of these soils is not a problem.

CAPABILITY UNIT IIs–4 (IRRIGATED)

This unit consists of deep, well-drained, nearly level soils in the Pima and Guest series. These soils have a clay surface layer that overlies moderately fine textured and fine textured material. They occur on flood plains and alluvial fans, mainly on the lower slopes of irrigated fields. The surface layer holds moisture for long periods of time and cracks when it dries. These soils hold about 2 inches of available water per foot of soil depth. In some areas these soils overlie loamy material or sand and gravel at a depth of 2 feet. The underlying sand and gravel holds less than 1 inch of water per foot of soil depth. These soils have good available moisture holding capacity. Permeability is moderately slow to slow, but in the underlying sand and gravel it is rapid. The average annual precipitation is about 9 inches. Runoff is slow to rapid, and the hazard of erosion is slight. Natural fertility is medium to high.

The soils in this unit are used for crops, mainly cotton, small grains, and grasses. Alfalfa and sorghum do not grow well, because the soils crack deeply when they dry. The crop rotation should include grass and green-manure or other soil-improving crops at least 25 to 50 percent of the time. Grasses suited to these clayey soils are good soil conditioners, for they help keep the soil material open to air and water. Tall wheatgrass is especially good, but alta fescue, Goars fescue, and bermudagrass also are good soil conditioners. All crop residue and some green-manure crops should be turned under. A good crop of grass plowed under adds organic matter, and adding barnyard manure is a good practice. Nitrogen added to nonleguminous crop residue speeds decomposition and is available to the following crop.

Because these soils swell when they are wet and crack when they dry, they are poorly suited to use as structural material or as sites for buildings.

These soils should be leveled to a grade of less than 0.1 percent and runs should be less than 1,320 feet for efficient use of irrigation water by gravity flow. In most places leveling can be done without damage to the soils, but deep cuts decrease fertility and the organic-matter content.

Because these soils are easily compacted, minimum tillage is needed. The soils should not be tilled when wet. Subsoiling and deep plowing can be used to break up compacted layers that have formed, and rough tillage helps to aerate the soils and improve water penetration.

CAPABILITY UNIT IIs–5 (IRRIGATED)

This unit consists of deep, well-drained, nearly level soils in the Agua and Maricopa series. These soils have a loam or clay loam surface layer that overlies medium-

textured or moderately coarse textured material. Gravelly sand or sand is below a depth of 2 or 3 feet, and it extends to a depth of 5 feet or more. The surface layer of the clay loam soil cracks when it dries. These soils hold about 2 inches of available water per foot of soil depth above the sand and gravel. The sand and gravel hold less than 1 inch per foot of depth. The available moisture holding capacity is fair. Permeability is moderate or moderately rapid above the sand and gravel and rapid in the sand and gravel. The water intake rate is moderate to moderately slow. The average annual precipitation is about 9 inches. Runoff is slow, and water erosion or soil blowing is not a problem. Natural fertility is low to high.

The soils of this unit are suited to all crops adapted to the survey area, but growth of deep-rooted crops is restricted. The main crops are alfalfa, small grains, sorghum, cotton, and grasses. Crop rotations containing a large proportion of row crops can be used without depleting fertility if these rotations are supported by the use of crop residue, green-manure crops, and other good practices. The organic-matter content and fertility can be maintained by using these practices. Nitrogen is needed for most crops, especially where the rotation does not include a legume, and phosphorus is needed for legumes. Where much crop residue is returned to the soils, nitrogen should be added to aid in decomposing the residue.

These soils should be leveled to a grade of less than 0.3 percent for efficient use of irrigation water by gravity flow. Special investigations are needed to determine the depth to which cuts can be made. Because of the underlying gravelly sand or sand, cuts 1 or 2 feet deep will damage the soils. If the area being leveled is small, the sand or gravel can be removed below grade and the space backfilled with good soil material. Bench leveling may be a better practice for larger fields.

Minimum tillage should be used, especially on soils that have clay loam texture. None of these soils should be cultivated when wet.

CAPABILITY UNIT IIs-6 (IRRIGATED)

This unit consists of deep, well-drained, nearly level soils in the Comoro and Anthony series. These soils have a sandy loam surface layer that overlies moderately coarse textured material. They hold about 1 inch of available water per foot of soil depth. The available moisture holding capacity is fair, and permeability is moderately rapid. The water intake rate is rapid. The average annual precipitation is about 9 inches. Runoff is slow to medium. Where these soils are not cultivated, they are susceptible to soil blowing. This hazard can be controlled in cultivated areas by using winter cover crops. Natural fertility is low to medium.

The soils in this unit have no special restrictions to use for crops, but growth is poor if the soils are not managed well. The main crops are cotton, alfalfa, small grains, sorghum, and grasses. Because permeability of these sandy loam soils is moderately rapid, irrigations should be light and about every 9 to 12 days. Much irrigation water will be lost through seepage if the ditches are not lined. Crop rotations should include alfalfa, grasses, or other soil-building crops at least 50 percent of the time. The content of organic matter in these soils is low because decomposition is rapid. Much organic matter can be added as crop residue and green manure. Most crops benefit from added nitrogen, and alfalfa and other legumes from added phosphorus.

These soils should be leveled to a grade of less than 0.3 percent for efficient use of irrigation water by gravity flow. Even where the grade is less than 0.1 percent, the length of runs should not exceed 660 feet. Leveling can be done without permanent damage to the soils.

CAPABILITY UNIT IIs-7 (IRRIGATED)

Only Pima loam is in this unit. It is deep, well drained, and nearly level. The underlying material is moderately fine textured or fine textured. This soil occurs in old drainage basins south of Stafford and developed in somewhat poorly drained material. Now it is well drained, but soluble salts in excessive amounts accumulate throughout the profile. This soil holds about 2 inches of available water per foot of soil depth, and the available moisture holding capacity is good. Permeability is moderately slow to slow, and the water intake rate is moderately slow. The average annual precipitation is about 9 inches. Runoff is slow, but there is a slight hazard of erosion by irrigation water. Soil blowing is not a problem.

The soil in this unit has some restrictions if used for crops because it contains soluble salts and has an easily dispersed surface layer. Salts are difficult to remove completely from the underlying material because the only water available is saline, but leaching can reduce the level of salts enough that plants will grow. Occasional deep irrigations are needed to leach out these salts. Natural fertility is medium to high.

Crop rotations should include crops that leave large amounts of residue, as well as grass and other soil-building crops, at least 50 percent of the time. Barley, or another green-manure crop, is needed to maintain the organic-matter content where row crops are grown. The fertility can be maintained by adding commercial fertilizer. Adding nitrogen aids the decomposition of crop residue.

Leveling this soil to a grade of less than 0.1 percent is needed for efficient use of irrigation water by gravity flow. A flat grade also allows ponding of irrigation water and aids in leaching out the harmful salts. On this soil, two leachings with irrigation water generally are needed each year. Damage to this soil from leveling is slight.

Because the soil material in the surface layer is readily dispersed, tillage should be kept at a minimum to reduce the risk of compacting or pulverizing the soil. Rough tillage helps to aerate the soil, and periodic subsoiling can be used to break up compacted layers.

CAPABILITY UNIT IIIs-1 (IRRIGATED)

This unit consists of deep, well-drained, nearly level soils in the Whitlock series. These soils have a loam or sandy loam surface layer that overlies moderately coarse textured material that is rich in lime. In some areas sand and gravel occur at a depth below 2 feet. These soils hold about 1.5 inches of available water per foot of soil depth, and their available moisture holding capacity is fair. Permeability and water intake rate are moderately rapid. The average annual precipitation is about 9 inches. Runoff

is medium to slow, and the hazard of water erosion or soil blowing is slight. Natural fertility is low to medium.

Because the soils in this unit are rich in lime, their use is restricted to crops that are not affected by lime-induced chlorosis. Such crops as sorghum, barley, and fescue should not be grown, but alfalfa and cotton may grow well. A cropping system is needed that leaves a large amount of crop residue on the soils. Adding barnyard manure, crop residue, and green manure helps to keep the soils open and reduces the effect of lime on plants. Fertility can be improved by adding nitrogen and phosphorus. Lime carbonates in the soils lock up such plant nutrients as phosphorus, iron, and zinc and also withhold water. Sulfur added to the soils helps to counteract the effects of lime, but it is expensive and results are slow. Because the amount of moisture available to plants on these soils is low, irrigations should be light and frequent. These soils are highly corrosive to metal fence posts and uncoated metal pipes.

Because leveling of these soils is restricted in places by the depth to sand and gravel, investigations of each field are needed before deep cuts are made. The grade in the direction of the rows should not exceed 0.2 percent for efficient irrigation by gravity flow.

CAPABILITY UNIT IIIs-2 (IRRIGATED)

This unit consists of deep, well-drained and excessively drained, nearly level soils in the Arizo, Brazito, and Maricopa series. These soils have a loam or sandy loam surface layer that overlies coarse-textured material. Sand or gravelly sand is at a depth of 12 to 36 inches. The surface layer holds from 1 to 2 inches of available water per foot of soil depth, and the available moisture holding capacity is poor. Permeability is moderately rapid to very rapid, and the water intake rate is moderate. The average annual precipitation is about 9 inches. Runoff is slow to medium, and the hazard of water erosion or soil blowing is slight.

The soils in this unit are droughty and are difficult to manage. They are suited only to crops that are drought resistant. Most crops can be grown, but a better use is for permanent pasture or hay. Coastal bermudagrass and Goars fescue are suitable pasture and hay plants. Crop rotations should include grass, alfalfa, or other soil-improving crops at least 50 percent of the time, and suitable supporting practices are needed to maintain or improve fertility. Irrigations should be light and frequent, and irrigation ditches should be lined to prevent seepage. The organic-matter content of these soils is low. It can be increased by adding green manure, barnyard manure, crop residue, and gin trash. Where large amounts of these materials are added, nitrogen is needed to aid decomposition.

Because leveling may damage these soils, investigation of each field is needed to determine the depth of sand or gravelly sand. Bench leveling can be used to avoid deep cuts. In areas where much of the surface layer is removed, the modified soil will be in a different unit.

CAPABILITY UNIT IVs-1 (IRRIGATED)

This unit consists of deep, excessively drained, nearly level soils in the Arizo and Brazito series. The surface layer is loam, gravelly loam, or gravelly sandy loam and overlies coarse-textured material. These soils hold less than 1 inch of available water per foot of soil depth, and their available moisture holding capacity is very poor. Permeability is rapid or very rapid, and the water intake rate is moderately rapid to very rapid. The average annual precipitation is about 9 inches. Runoff is slow, and the hazard of water erosion or soil blowing is none to slight. Natural fertility is very low to low.

The soils in this unit are droughty and are poorly suited to cultivated crops. Nevertheless, they occur as small areas in cultivated fields. Areas large enough to be managed separately are better suited to permanent pasture. Coastal bermudagrass is suitable as permanent pasture, and alfalfa grows well if it is irrigated frequently. Large additions of nitrogen and phosphorus are needed to maintain good growth. Irrigations of all crops should be light and frequent, and the ditches should be lined to prevent seepage. Where these soils are not irrigated, they are nearly barren and have little value as desert range or wildlife habitat.

These soils should be leveled to a nearly flat grade, and irrigation runs should not be more than 660 feet long. Leveling can be done without severe damage to the soils, though large amounts of organic matter are needed on cut areas.

CAPABILITY UNIT IVs-2 (IRRIGATED)

Only Tidwell sandy loam, 0 to 2 percent slopes, is in this unit. It is well drained, nearly level, and moderately coarse textured. Sandstone and shale are at a depth of 1 to 2 feet. This soil holds about 1.5 inches of available water per foot of soil depth, and the available moisture holding capacity is very poor. Permeability is moderately rapid to moderate. The underlying sandstone is slightly permeable to water, and when it is moist it can be broken with a plow. The average annual precipitation is about 9 inches. Runoff is slow, and the hazard of water erosion or soil blowing is slight. Natural fertility is low.

Because it is shallow to bedrock and has very poor moisture holding capacity, the soil in this unit is suited mainly to permanent pasture, but under intensive management it can be cultivated. Small grains and truck crops can be grown, but frequent light irrigations are needed. Root penetration and internal drainage are limited by the underlying sandstone and shale. The pasture plants suited to this soil are Coastal bermudagrass and tall wheatgrass. If the quality of irrigation water is good, Goars fescue grows well. Large amounts of nitrogen are needed for grasses, and they also benefit from annual additions of phosphorus.

Leveling should be limited to making the irrigation grade uniform and removing side slopes in a field. Deep cuts should be avoided.

CAPABILITY UNIT VIIe-1 (DRYLAND)

This unit consists of deep and shallow, well-drained, gently sloping to moderately steep soils in the Cave and Whitlock series. The surface layer is gravelly sandy loam or sandy loam. These soils are highly calcareous throughout their profile. They hold about 1.25 inches of available water per foot of soil depth. The available moisture holding capacity is very poor or poor, depending on depth. Permeability is moderate or moderately rapid, and the water intake rate is rapid. The average

annual rainfall is about 9 inches, but only about 3 to 6 inches can be used by plants. The rest runs off, and the hazard of water erosion ranges from slight to high. The hazard of soil blowing is slight to moderate. Natural fertility is low.

Vegetation on the soils in this unit provides a limited amount of grazing for livestock after periods when moisture is favorable. The vegetation consists mainly of creosotebush, cactus, saltbush, and annual weeds and grasses. Management of these soils for range includes quick grazing of not more than half of the forage in the sparse stand of annual weeds and grasses and removing the livestock early enough to allow desirable annuals to produce seed. Other range improvement is not practical. Some plant cover is needed on these soils to control erosion.

The amount of water supplied by runoff from these soils is high during rainstorms and during long periods of rainfall. Some of the vegetation is eaten by wildlife. In most places these soils are too steep for general use as recreational areas.

CAPABILITY UNIT VIIs-1 (DRYLAND)

This unit consists of deep, well-drained, nearly level and gently sloping soils in the Agua, Anthony, Comoro, Continental, Gila, Maricopa, Pima, and Pinaleno series. The surface layer ranges from loam to gravelly sandy loam in texture, and the underlying material ranges from moderately fine to moderately coarse. In some areas gravelly sand is below a depth of 2 feet. These soils hold from 0.75 inch to 2 inches of available water per foot of soil depth, and the available moisture holding capacity ranges from poor to good. Permeability ranges from slow to moderately rapid, and the water intake rate is moderate to rapid. The average annual precipitation is about 9 inches, but only about 4 to 7 inches can be used by plants. The rest runs off, but the hazard of water erosion is slight. Fertility ranges from low to high.

Vegetation on the soils in this unit provides limited seasonal grazing for cattle and horses. The vegetation consists mainly of mesquite, catclaw, willow, cactus, and Mormon-tea. Fairly large amounts of annual weeds and grasses grow after a favorable growing period in summer. Management of these soils for range includes quick grazing of not more than half of the forage produced by annuals and removing the livestock early enough to allow the desirable plants to produce seed. Fencing into smaller units and developing watering places are helpful, but other range improvement generally is not practical. Because of low rainfall, seeding for range is not practical.

The amount of water supplied from these soils is moderate to high, and the water generally is free of sediment except in local drainageways. Brush on these soils provides food and shelter for some kinds of wildlife.

CAPABILITY UNIT VIIs-2 (DRYLAND)

This unit consists of deep, well-drained, saline soils in the Gila, Glendale, and Grabe series. These soils are nearly level, and the soil material in the surface layer is readily dispersed. Texture throughout the profile ranges from loam to silty clay loam. These soils contain salts that restrict the kinds of plants that can be grown. They hold about 1.5 inches of available water per foot of soil depth. Because moisture seldom penetrates below a depth of 2 feet, the available moisture holding capacity is poor. The surface of these soils seals readily because of the high content of salts. Permeability and the water intake rate are moderate to slow. The average annual precipitation is about 9 inches, but only about 2 or 3 inches can be used by plants. The rest runs off at a medium to rapid rate, and the hazard of water erosion is slight to moderate. Natural fertility is medium to low.

Vegetation on the soils in this unit provides limited seasonal grazing for cattle and horses. The vegetation consists mainly of saltbush and some creosotebush, saltcedar, cholla and other cactus, suaeda, Russian-thistle, pickleweed, and annual weeds and grasses. The saltbush, saltcedar, and annual weeds and grasses provide some grazing after a favorable growing period in summer. Management of these soils for range includes quick grazing of not more than half the forage produced by the annuals and removing the livestock early enough to allow the desirable annuals to produce seed. Other range improvement generally is not practical. Because of low rainfall and a high content of salt, seeding these soils for range is not feasible.

CAPABILITY UNIT VIIs-3 (DRYLAND)

This unit consists of deep, well-drained, nearly level to gently sloping soils in the Arizo and Brazito series and a land type, Gravelly alluvial land. Texture of these soils ranges from loam to gravelly sandy loam. These soils hold about 0.75 inch of available water per foot of soil depth, and their available moisture holding capacity is very poor to poor. Permeability and water intake rate are rapid to very rapid. The average annual precipitation is 9 or 10 inches, but only about 5 to 8 inches can be used by plants. The rest runs off, but the hazard of water erosion is slight. Natural fertility is low or very low.

The soils in this unit are used along with other adjacent soils for seasonal or, in some places, year-long grazing. The vegetation consists mainly of mesquite, catclaw, creosotebush, willow, cactus, and annual weeds and grasses. Management of these soils for range necessarily is the same as the management of the adjoining soils. Generally, range improvement is not practical, but whatever is done to improve or maintain range on adjoining soils benefits these soils.

Runoff is not generally in large amounts, and little sediment is carried. During periods of heavy rainfall runoff is very rapid and turbulent, and much moving and sorting of coarse material occurs. These soils provide a good source of sand and gravel. In the higher areas, these soils have a thicker stand of vegetation and wildlife is fairly abundant.

CAPABILITY UNIT VIIs-4 (DRYLAND)

This unit consists of deep, well-drained, nearly level to sloping soils in the Bitter Spring, Cave, Continental, and Pinaleno series. The surface layer is gravelly or cobbly loam and sandy loam. A strongly cemented layer of accumulated lime is at a depth ranging from 2 to more than 3 feet. These soils hold about 1.5 to 2 inches of available water per foot of soil depth. Permeability is moderate to very slow, and the water intake rate is mod-

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erate. The average annual precipitation is about 9 inches, but only 2 to 8 inches can be used by plants. The rest runs off, but the hazard of water erosion is slight. There is also a slight hazard of soil blowing. Natural fertility is medium to high.

Vegetation on the soils in this unit provides seasonal grazing for livestock. When precipitation is heavy in winter and favorable in summer, fair stands of annual weeds and grasses grow. Additional plants are creosotebush, cactus, fluffgrass, whitethorn, and tobosa. Management of these soils for range includes quick grazing of not more than half the forage produced by annual and perennial plants and removing the livestock early enough to allow these plants to produce seed. Fencing into smaller units and developing watering places are helpful, but other range improvement generally is not practical.

Runoff from these soils adds a moderate amount of water to the Gila River, but only intense rainstorms or long periods of rainfall produce measurable runoff. These soils provide a habitat for moderate to large numbers of wildlife—mainly rabbits, quail, doves, and deer—particularly in areas near the mountains.

CAPABILITY UNIT VIIs-5 (DRYLAND)

Only Graham extremely rocky clay loam, 2 to 40 percent slopes, is in this unit. It is shallow and well drained. This soil has a gravelly and cobbly clay loam surface layer and gentle to moderately steep slopes. Bedrock is at a depth of 8 to 20 inches. This soil holds about 1.5 to 2 inches of available water per foot of soil depth, and the available moisture holding capacity is poor. Permeability is moderately slow to slow, and the water intake rate is moderate to moderately slow. The average annual precipitation is about 11 inches, but only 5 to 7 inches can be used by plants. The rest runs off, but water erosion or soil blowing is not a hazard. Natural fertility is medium to high.

Vegetation on this soil provides year-long grazing for cattle. The vegetation consists of tobosa, curly mesquite, wolfberry, ocotillo, Mormon-tea, coffeeberry, snakeweed, side-oats grama, and annual weeds and grasses. Management of this soil for range includes grazing not more than half the forage produced by annual and perennial grasses, weeds, and shrubs. Deferred grazing and rotation-deferred grazing are desirable for maintaining or improving the range. Because of the rough physical features and steep slopes, fencing into smaller units and developing additional watering places generally are helpful. In some places, trails can be built to enable the livestock to reach good grazing areas that otherwise are inaccessible. Because of low rainfall and roughness, seeding for range on this soil is not likely to increase the amount of forage very much. It could succeed only in a very favorable year. Also, little use can be made of mechanical equipment for improvement of range.

Runoff from this soil adds a small amount of water to the Gila River.

CAPABILITY UNIT VIIs-6 (DRYLAND)

Only one mapping unit, Cellar soils, 2 to 50 percent slopes, is in this capability unit. These soils are shallow and well drained. The surface layer is cobbly very gravelly sandy loam. Depth to bedrock ranges from 5 to 14 inches. These soils hold about 0.75 inch of available water per foot of soil depth, and their available moisture holding capacity is very poor. Permeability is moderately rapid, and the water intake rate is rapid. The average annual precipitation is about 11 inches, but only about 3 to 8 inches can be used by plants. The rest runs off, but water erosion or soil blowing is not a hazard. Natural fertility is low.

Vegetation on this unit provides year-long grazing for cattle and horses. This vegetation consists of snakeweed, catclaw, ocotillo, cactus, three-awn, lovegrass, and annual plants. Management of this unit for range includes grazing not more than half the forage produced by desirable perennial grasses, shrubs, and weeds. Deferring grazing until after the growing season or rotation-deferred grazing can be used to maintain and improve the range. Because of physical features, fencing into smaller units generally is needed, and developing watering places also is helpful. Building livestock trails in the steepest and roughest areas is either needed or desirable. Because of low rainfall and a stony surface, seeding these soils for range is not practical and could succeed only in the most favorable years. Also, little use can be made of mechanical equipment for range improvement.

Runoff from these soils adds a small to moderate amount of water to the Gila River.

CAPABILITY UNIT VIIs-7 (DRYLAND)

This unit consists of shallow to deep, well-drained, nearly level to gently sloping soils in the Bitter Spring, Cave, Continental, Gila, Pinaleno, Tres Hermanos, and Whitlock series. The surface layer ranges from loam to gravelly sandy loam. These soils are calcareous and occur in basinlike depressions and on hillsides. They hold from 1 inch to 2 inches of available water per foot of soil depth, and their available moisture holding capacity ranges from very poor to fair. Permeability ranges from moderately slow to moderately rapid, and the water intake rate is moderate to slow. The average annual precipitation is about 9 inches, but only 3 to 6 inches can be used by plants. The rest runs off, but the hazard of water erosion is slight. There is also a slight hazard of soil blowing. Natural fertility is low to medium.

Some vegetation on the soils in this unit is used for seasonal grazing. Where precipitation is above average in winter and favorable in summer, a sparse stand of annual weeds and grasses grow, but the year-round vegetation consists of creosotebush, cactus, senna, whitestem paperflower, Mormon-tea, wolfberry, fluffgrass, bush muhly, and ocotillo. Most of this year-round vegetation has no value for grazing. Management of these soils for range includes quick grazing of not more than half the forage produced by the annual weeds and grasses and removing the livestock early enough to allow desirable annuals to produce seed. Other range improvement is not practical.

Runoff from these soils adds little water to the Gila River, because most of the water sinks into the dry, gravelly bottoms of washes. These soils are highly corrosive to metal fence posts and uncoated pipes.

CAPABILITY UNIT VIIs-8 (DRYLAND)

This unit consists of shallow, well-drained, nearly level to gently sloping soils in the Gila, Glendale, and Tidwell

series and the miscellaneous land type, Rock land. The surface layer of the soils is mainly sandy loam. Rock land consists of 60 to 70 percent rock outcrop and 30 to 40 percent shallow, stony and gravelly soils. Slopes of Rock land range from 5 to 50 percent. The soils in this unit hold 0.5 inch to 2 inches of available water per foot of soil depth, and the available moisture holding capacity is very poor. Permeability is moderately rapid to moderate above bedrock, and the water intake rate is moderate to rapid. The average annual precipitation is about 9 inches, but only about 3 to 5 inches can be used by plants. The rest runs off, but the hazard of water erosion is slight to moderate, depending on the slope and amount of plant cover. Natural fertility is low.

The soils in this unit are used for both seasonal and year-round grazing for cattle and horses. Vegetation on Rock land consists mainly of annual weeds and grasses, coffeeberry, paloverde, cactus, senna, Mormon-tea, tobosa, cottontop, and bush muhly; vegetation on the soils consists mainly of creosotebush, mesquite, and annual weeds and grasses. Management of this unit for range includes grazing of not more than half the forage produced by perennial grasses, shrubs, and annual weeds and grasses. Fencing into small units and developing watering places and livestock trails aid in management, but other range improvement is not practical.

Except for maintaining some plant cover, little can be done on these soils to control runoff and erosion. Runoff carries little sediment. Deer make some use of the shrubs on Rock land, but because the vegetation is sparse, the number of wildlife on the soils in this unit is small.

CAPABILITY UNIT VIIc-1 (DRYLAND)

This unit consists of deep, well-drained, nearly level to gently sloping soils in the Gila, Glendale, and Grabe series. The surface layer ranges from loam to gravelly sandy loam in texture and overlies medium-textured to moderately fine textured material. These soils hold about 2 inches of available water per foot of soil depth, and the available moisture holding capacity is good. Permeability is moderate to moderately slow, and the water intake rate is moderate to rapid. The average annual precipitation is about 9 inches, but only about 3 to 6 inches can be used by plants. The rest runs off, but the hazard of water erosion is slight. There is also a slight hazard of soil blowing. Natural fertility is medium to high.

Vegetation on the soils in this unit provides limited seasonal grazing for cattle and horses. It consists mainly of mesquite, catclaw, willow, cactus, and Mormon-tea, but fairly large amounts of annual weeds and grasses grow after favorable rainfall in summer. Management of these soils for range includes quick grazing of not more than half the forage produced by the annual plants and removing the livestock early enough to allow the desirable annuals to produce seed. Fencing into smaller units and developing watering places are helpful, but other range improvement is not practical. Because rainfall is low, seeding for range is not practical.

The amount of water supplied by runoff from these soils is moderate, and the water generally contains little sediment. Brush on these soils provides food and shelter for some kinds of wildlife.

CAPABILITY UNIT VIIIw-1 (DRYLAND)

Only Riverwash, a miscellaneous land type, is in this unit. This land type consists of nearly barren or barren, sandy and gravelly areas that frequently are flooded. Little moisture is held available to plants because permeability is very rapid. The average annual precipitation ranges from 9 to 11 inches, but most of it runs off, and the hazard of erosion is moderate to high. Natural fertility is low.

This land type is not suited to the production of commercial plants, and its use for grazing is extremely limited. Some areas are used by deer, javelina, Gambel quail, scaled quail, and migratory waterfowl and should be managed to maintain this use. Other possible uses for this land type are as a source of sand and gravel and for wildlife and water supply. Some areas can be used for limited recreation.

CAPABILITY UNIT VIIIs-1 (DRYLAND)

Only Rough broken land, a miscellaneous land type, is in this unit. This land type consists of steep and very steep areas between terraces of different levels. These areas have a sparse stand of vegetation. Little moisture is held available for plants, because permeability is moderate to rapid. The average annual precipitation ranges from 9 to 11 inches, but most of it runs off. The hazard of erosion ranges from slight to moderate.

This land type is not suited to the production of commercial crops, but it provides limited grazing. Some areas are used by deer, javelina, Gambel quail, and scaled quail, and these areas should be managed to maintain this use. Other possible uses are as a source of sand and gravel and for water supply or recreational areas.

Estimated Yields [4]

Table 2 gives estimated yields of the principal crops and pasture grown on irrigated soils under a moderately high level of management. Table 2 also rates the suitability of irrigated soils for growing fruit and nut trees. A moderately high level of management includes the following practices:

1. Using adequate irrigation water efficiently.
2. Planting adapted varieties of crops.
3. Choosing a suitable cropping system.
4. Using fertilizer according to the results of soil tests.
5. Tilling according to improved methods.
6. Returning crop residue and adding manure to the soil.
7. Controlling pests and diseases.

Soils are rated *good* in table 2 if they have few or no limitations for growing fruit and nut trees; *fair* if they have some limitations; *poor* if they have many limitations; and *not suitable* if fruit and nut trees cannot be grown. Yields for fruit and nut trees are not available for the survey area, and estimates could not be made.

[4] THOMAS W. TURNER, work unit conservationist, Soil Conservation Service, and JOHN L. SEARS, county agricultural agent, Agricultural Extension Service, assisted in preparing this section.

TABLE 2.—*Estimated acre yield of principal crops on irrigated soils under a moderately high level of management, and suitability of soils for fruit and nut trees*

[Absence of yield indicates that the soil is generally not suited to the crop]

Soil	Cotton		Alfalfa	Sorghums		Barley grain	Pasture grasses			Suitability of soils for pecan, peach, apricot, and similar trees
	Short staple	Long staple		Grain	Silage		Fescue	Bermuda-grass	Tall wheat	
	Bales	*Bales*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	
Agua clay loam	2	1¼	7	2¼	22	1¾	7	7	7	Fair.
Agua loam	2	1½	7	2¼	21	1¾	7	7	7	Fair.
Anthony clay loam, 0 to 2 percent slopes	2	1¼	8	2¼	23	1¾	7	7	6	Good.
Anthony loam, 0 to 2 percent slopes	2	1¼	8	2¼	22	1¾	7	7	6	Good.
Anthony sandy loam, 0 to 2 percent slopes	1¾	1½	7	2	18	1½	6	7	4	Good.
Arizo sandy loam, 0 to 2 percent slopes	------	------	4	------	------	------	------	4	------	Not suitable.
Arizo gravelly sandy loam, 0 to 2 percent slopes	------	------	------	------	------	------	------	3	------	Not suitable.
Arizo loam, 0 to 2 percent slopes	------	------	5	------	------	------	------	5	------	Not suitable.
Arizo gravelly loam, 0 to 2 percent slopes	------	------	4	------	------	------	------	4	------	Not suitable.
Brazito loam	------	------	5	------	15	1¼	------	5	------	Fair.
Brazito sandy loam	------	------	5	------	15	1¼	------	5	------	Poor.
Comoro loam	2	1¼	8	2¼	22	1¾	7	7	7	Good.
Comoro sandy loam	1¾	1½	7	2	18	1½	6	7	4	Good.
Comoro loam, mottled variant	1¾	1½	6	1½	18	1½	6	7	6	Good.
Gila gravelly loam, 0 to 2 percent slopes	2	1½	7	2¼	22	1¾	7	8	7	Good.
Gila loam, 0 to 2 percent slopes	2½	1¾	8	2¾	26	2	8	8	8	Good.
Gila loam, saline, 0 to 2 percent slopes	2	1¼	6	2	20	1¼	6	7	7	Poor.
Gila sandy loam, 0 to 2 percent slopes	2	1½	7	2¼	22	1¾	7	8	7	Good.
Glendale loam	2	1½	6	2¼	22	1¾	8	8	8	Good.
Glendale silt loam, saline	2	1¼	6	2	20	1½	6	7	7	Poor.
Glendale silt loam, saline-alkali	1¾	1	6	2	20	1½	6	7	7	Poor.
Glendale silty clay loam, saline	2	1¼	6	2	20	1½	6	7	7	Poor.
Grabe clay loam	2½	1½	8	2¾	26	1¾	8	8	8	Good.
Grabe loam	2½	1¾	8	2¾	26	2	8	8	8	Good.
Grabe loam, saline	2	1¼	6	2	20	1¼	6	7	7	Poor.
Guest clay	2	1½	6	2¼	22	1¾	8	8	8	Fair.
Maricopa loam	1¾	1½	6	2	20	1½	6½	6½	5½	Fair.
Maricopa sandy loam	1½	1½	6	1¾	17	1¼	4	6	4	Fair.
Pima clay	2	1½	6	2¼	22	1¾	8	8	8	Fair.
Pima clay loam	2	1½	6	2¼	23	1¾	8	8	8	Good.
Pima clay loam, saline	2	1¼	6	2	20	1½	6	7	7	Poor.
Pima loam	1¾	1¼	6	2¼	21	1½	7	8	8	Fair.
Tidwell sandy loam, 0 to 2 percent slopes	------	------	------	------	16	¾	4	6½	4	Not suitable.
Whitlock loam, 0 to 2 percent slopes	1½	1	7	------	------	------	------	6	------	Not suitable.
Whitlock sandy loam, 0 to 2 percent slopes	1½	1	6	------	------	------	------	6	------	Not suitable.

The estimates in table 2 are based on observations made by the soil scientists who made the survey; on information furnished by farmers; and on records by farm people employed by the Agricultural Extension Service, Soil Conservation Service, and the Agricultural Experiment Station. Data from the census of agriculture and local census were also considered. Where little or no information was available, the estimates were made by comparing the yields with those of similar soils.

Important limitations that the reader should keep in mind when using table 2 are that the figures are only estimates, or predictions, and that they represent averages that can be expected over a period of years. In any given year the yields may be considerably higher or lower than the average. Also, there may be some variations of conditions within some soils from year to year. For example, the amount of salts or alkali in a soil may increase or decrease and therefore affect the yields.

Estimates of yields are most useful when the management practices are known. The yields in table 2 can be expected if the general practice in the section "Management of Irrigated Soils" and the more specific practices described under the capability units are followed. The yields in table 2 can be sustained or increased by adding fertilizer of the kind and in the amount determined by the results of soil tests. Information for sustaining or increasing yields of a specified crop on each kind of soil is available through the local office of the Agricultural Extension Service. This information is based on research and experience that has been most successful.

Irrigation Water

Discussed in the following paragraphs are the quantity and quality of irrigation water in the Safford Area and the use of this water for removal of salts and sodium from soils.

The quantity of water available for irrigation in the inner valley is usually sufficient for all agricultural purposes. As the crop year progresses from spring to fall, however, the level of water in the Gila River and in most wells goes down, and even the flow from a few arte-

sian wells diminishes. The level of water in the river is restored and ground water recharged in winter and early in spring from rainfall and snowmelt.

The quality of water available for irrigation ranges from poor to good and depends on the kind and amount of salts that are dissolved in the water. Water that is suitable for home use is not necessarily suitable for use in irrigation. Soft water, for example, contains a high percentage of sodium and is harmful when used for irrigation. All available water in any part of the survey area is not good, but neither is it all poor in quality. When wells in the inner valley were sampled, only a few had water of good quality, several had water of fair quality, but many had water of poor quality. Wells as close as a quarter of a mile apart may have water of different quality, depending on location, and adjacent wells may have different quality of water, depending on depth. Water from most artesian, or flowing, wells is poor because the wells are deep. The quality of water in the Gila River varies as the amount of water in the channel varies. As the amount decreases, the quality of the water decreases.

Four classes of salinity in soils and four of sodium are recognized by the U.S. Department of Agriculture (*5*). The limits of these classes are determined by field tests and laboratory experiments. In classifying irrigation water, it is assumed that the water will be used under average conditions with respect to (1) soil texture; (2) movement of water into the soil; (3) soil drainage; (4) quantity of water; and (5) salt tolerance of the crop irrigated. Large deviations from normal for one or more of these conditions may make it safe to use water that, under average conditions, would be of doubtful quality. Conversely, water that ordinarily would be of good quality may be unsafe for irrigation. Primarily because most crops grown in the Safford Area are salt tolerant, a classification of water on basis of salt content may be somewhat more severe than actual conditions warrant. Information for interpreting the classification of water for a specific soil is available at the office of the county agricultural agent.

Irrigation water can be used to remove excess soluble salts from soils by leaching. If the soils are flooded, the water will dissolve the salt and carry it below the depth penetrated by roots. Approximately 50 percent of the soluble salts can be leached out of a soil by applying 6 inches of water for each foot of soil depth. If 12 inches of water is applied, about 80 percent of the salts can be removed. More water is required to remove the salts where flooding is not used. Removing salts from all irrigated soils in the Safford Area should be fairly easy, but removal is less easy from the Glendale and Pima soils.

Irrigation water can be used to remove sodium and excess soluble salts from saline-alkali soils by leaching (*11*). In many soils leaching with saline water gives best results because the saline water flocculates the soil material and makes it more permeable (*11*). If the saline water contains more than 50 percent calcium, the calcium replaces sodium in the soil. After several successive leachings with this saline water, the saline-alkali soils are suitable for farming. The permeability will also be retained. Removal of sodium will be improved if the content of salt in the water is reduced in each successive leaching. In some soils, gypsum or some other soil amendment may be needed to supply calcium to replace the sodium that is removed. This need for a soil amendment and the kind and amount are best determined by laboratory tests. Information about soil amendments for a specific soil is available through the office of the county agricultural agent.

Engineering Uses of Soils

Some soil properties are of special interest to the engineer because they affect construction and maintenance of roads, airports, pipelines, foundations for buildings, facilities for water storage, erosion control structures, drainage systems, and sewage-disposal systems. The properties most important are permeability to water, shear strength, compaction characteristics, soil drainage, shrink-swell potential, grain size, plasticity, and reaction (pH). Depth to water table, depth to bedrock, and topography are also important.

The information in this survey can be used by engineers to—

1. Make soil and land use studies that will aid in selecting and developing industrial, business, residential, and recreational sites.
2. Make preliminary estimates of the engineering properties that will help in the planning of agricultural irrigation systems, farm or ranch ponds, and diversion terraces.
3. Make preliminary evaluations of soil conditions that will aid in selecting highway, airport, pipeline, and cable locations and in planning detailed investigations at the selected locations.
4. Locate probable sources of sand, gravel, or other construction materials.
5. Correlate performance of engineering structures with soil mapping units to develop information for planning that will be useful in designing and maintaining the structures.
6. Determine the suitability of soil mapping units for cross-country movement of vehicles and construction equipment.
7. Supplement the information obtained from other published maps and reports and aerial photographs to make maps and reports that can be used readily by engineers.
8. Develop other preliminary estimates for design or construction purposes based on soil conditions pertaining to the particular area.

To make the best use of the soil map and the soil survey, the engineer needs to know the properties of the soil materials and the condition of the soils in place. After testing these materials and observing the behavior of the soils when used in engineering structures and foundations, the engineer can make design recommendations for the soils shown on the soil map.

With the soil map for identification, the engineering interpretations reported here can be useful for many purposes. It should be emphasized that they may not eliminate the need for sampling and testing at the site

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of specific engineering works that involve heavy loads or where excavations are deeper than the depths of layers reported here. Even in these situations, however, the soil map is useful for planning more detailed field investigation and for suggesting the kinds of problems that may be expected.

Much of the information in this section is given in tables. Test data on samples of three extensive soil series are given in table 3. Properties of the soils significant to engineering are given in table 4. Engineering classifications (AASHO and Unified) of the soils are listed in both tables 3 and 4. Engineering interpretations are given in table 5.

Some of the terms used by soil scientists may not be familiar to the engineer. Other terms, though familiar, may have a special meaning in soil science. Most of these terms are defined in the Glossary at the back of this survey.

Engineering classification systems

Two systems of classifying soils are in general use by engineers. Both of these systems are used in this survey.

Many engineers use the system of soil classification developed by the American Association of State Highway Officials (AASHO) (*1*). In this system, soils are placed in seven main groups on the basis of field performance. These groups range from A–1 (gravelly soils having high bearing capacity) to A–7 (clayey soils having low strength when wet). The best soils for road subgrade are therefore classified A–1, the next best A–2, and the poorest, A–7. Within each group the relative engineering value of the soil material is indicated by a group index number. Group index numbers range from 0 for the best material to 20 for the poorest. These numbers are shown in parentheses after the classification symbols in table 3.

The Unified system of soil classification was established by the Corps of Engineers, U.S. Army (*12*). This system is based on the texture and plasticity of soils and the performance of the soils as material for engineering works. Of the 15 classes in this system, 8 are for coarse-grained material, 6 for fine-grained material, and 1 for highly organic material. Each class is identified by a letter symbol. Soils in class CL are silts and clays that have a low liquid limit. CH identifies inorganic clays that are highly plastic. Soils in class SC are sands mixed with an appreciable amount of fines, mostly silt. GP identifies poorly graded gravel.

Engineering test data

Samples of the principal soil types of three soil series were tested by the Arizona State Highway Department, Materials Division, according to standard procedures so that the data obtained could be used in evaluating the

TABLE 3.—*Engineering*

[Tests performed by the Arizona State Highway Department, Materials Division, in cooperation with the U.S. Bureau of

Soil name and location	Arizona report No.	Depth	Moisture-density [1]	
			Maximum dry density	Optimum moisture
		Inches	*Lbs. per cu. ft.*	*Percent*
Gila loam:				
SE¼ section 6, T. 6 S., R. 25 E.	63–16991	0–6	106	16
	63–16992	6–22	108	15
	63–16993	39–66	121	10
Center of section 5, T. 7 S., R. 26 E.	63–16994	0–9	100	18
	63–16995	9–60	110	11
Grabe clay loam:				
SE¼ section 17, T. 7 S., R. 26 E.	63–16989	0–11	98	21
	63–16990	34–66	109	16
Grabe loam:				
SW corner of section 29, T. 6 S., R. 25 E.	63–16996	0–11	99	19
	63–16997	11–48	116	12
Pinaleno gravelly loam:				
SE¼ section 20, T. 7 S., R. 27 E.	63–16985	2–9	119	11
	63–16986	14–30	(4)	(4)
NE¼ section 24, T. 7 S., R. 25.	63–16987	0–2	125	9
	63–16988	12–30	(4)	(4)

[1] Based on AASHO Designation: T 99–57, Method C (*1*).

[2] Mechanical analyses according to AASHO Designation T 88–57 (*1*). Results by this procedure frequently differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method, and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analysis data in this table are not suitable for naming textural classes for soils.

soils for engineering purposes. The test data are shown in table 3. Because samples for these tests were obtained to a depth of only 6.5 feet or less, the data may not be adequate for estimating the characteristics of soil materials in deep cuts.

The engineering soil classifications in table 3 are based on mechanical analyses and tests to determine the liquid limit and plastic limit. Mechanical analyses were made by the combined sieve and hydrometer methods.

The tests for liquid limit and plastic limit measure the effect of water on the consistence of the soil material. As the moisture content of a dry clayey soil increases, the material changes from a semisolid to a plastic state. As the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material passes from a semisolid to a plastic state. The liquid limit is the moisture content at which the material passes from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is in a plastic condition.

As the moisture content is increased in a soil being compacted by a constant effort, density of the soil will increase until the optimum moisture content is reached. If additional moisture is added, the density of the compacted soil will decrease. The highest dry density that can be obtained in compaction tests is termed "maximum dry density." The moisture-density relationship is important in earthwork because optimum stability is obtained when a soil is compacted to its maximum density at optimum moisture content.

Soil properties significant to engineering

The soil series in the Safford Area and estimates of their physical and chemical properties important to engineering are shown in table 4. The estimates were made according to layers that have properties significant to engineering, and the depths shown for the layers may not be the same as the depths in the section "Descriptions of the Soils," because some of these layers were combined in table 4. The texture of each layer is listed according to the textural classification of the United States Department of Agriculture (*8*). Also listed for each layer are the estimated percentages that will pass a No. 4 sieve, a No. 10 sieve, and a No. 200 sieve.

The column that shows permeability gives the estimated rate, in inches per hour, that water moves through a soil in place.

Available water capacity is defined in the Glossary as available moisture holding capacity.

The acid or alkaline reaction of the soil is expressed as a range in pH values. A pH of 7.0 is neutral; values lower than 7.0 are acid; and values higher are alkaline.

test data

Public Roads (BPR), according to standard procedures of the American Association of State Highway Officials (AASHO) (*1*)]

Mechanical analysis [2]								Liquid limit	Plasticity index	Classification	
Percentage passing sieve—					Percentage smaller than—					AASHO	Unified [3]
¾-in.	No. 4 (4.76 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	(0.02 mm.)	(0.005 mm.)	(0.001 mm.)				
100	97	95	90	77	40	18	4	32	12	A-6(9)	CL
100	100	100	98	85	34	16	6	31	11	A-6(8)	CL
95	82	74	59	42	14	7	5	25	4	A-4(1)	SM-SC
100	100	100	96	85	60	24	6	38	15	A-6(10)	ML-CL
100	100	99	96	83	49	26	11	29	11	A-6(9)	CL
100	100	100	96	82	68	42	12	48	30	A-7-6(18)	CL
100	100	100	97	71	37	17	9	30	11	A-6(8)	CL
100	100	100	96	87	58	27	10	37	17	A-6(11)	CL
100	100	99	85	53	24	12	7	22	2	A-4(4)	ML
90	75	70	57	37	20	10	4	27	11	A-6(1)	SC
51	22	18	15	12	9	5	2	63	43	A-2-7(0)	GP-GC
92	75	71	51	27	10	6	4	22	4	A-2-4(0)	SM-SC
61	30	23	13	8	6	5	2	50	34	A-2-7(0)	GW-GC

[3] Based on the Unified Soil Classification System (*12*). SCS and the Bureau of Public Roads have agreed to consider that all soils having plasticity indexes within two points from the A-line are to be given a borderline classification. Examples of borderline classifications are GP-GC and SM-SC.

[4] Contains too much coarse material for accurate determination by the method used.

TABLE 4.—*Estimated engineering properties*

[Gravelly alluvial land (Gv), Riverwash (Rh), Rock land (Rk), and Rough broken land (Ro) are

Soil series and map symbol	Depth	Classification		
		Dominant USDA texture	Unified	AASHO
	Inches			
Agua (Ac, Ag).	0–27	Loam	ML to CL	A–4
	27–45	Stratified gravelly sand to very gravelly sand.	GP GM	A–1
Anthony (AhA, AlB, AmA, AnA, ApB, AtA). (For properties of the Continental and Pinaleno soils in mapping unit ApB and Gila soil in mapping unit AtA, refer to the respective series in this table.)	0–46	Sandy loam	SM	A–4, A–2
	46–60	Very gravelly sandy loam	GP	A–1
Arizo (AuA, AwA, AvA, AvB, AzA).	0–8	Loam, sandy loam, gravelly loam, or gravelly sandy loam.	SM	A–2 or A–4
	8–40	Very gravelly sandy loam and very gravelly and cobbly sand.	GP–GM	A–2
Bitter Spring (BeB, BpB). (For properties of the Pinaleno soil in mapping unit BpB, refer to the Pinaleno series in this table.)	0–52	Gravelly loam	SM	A–2
Brazito (Br, Bt).	0–10	Loam to sandy loam	SM	A–2 or A–4
	10–50	Sand	SP	A–3
Cave (ChB, ChE, CkD). (For properties of the Pinaleno soil in mapping unit CkD, refer to the Pinaleno series in this table.)	0–12	Gravelly sandy loam to gravelly loam.	SM	A–2
	12–24	Caliche		
Cellar (ClF).	0–9	Cobbly very gravelly sandy loam.	GM	A–2
	9–16	Bedrock.		
Comoro (Cm, Cn, Co).	0–60	Loam, sandy loam, loamy fine sand, and stratified silt loam.	SM	A–2 or A–4
Continental (CrB, CtB, CsB). (For properties of the Pinaleno soil in mapping unit CtB, and of the Gila soil in mapping unit CsB, refer to the respective series in this table.)	0–29	Cobbly clay or gravelly clay	CL	A–4, A–6, or A–7.
	29–50	Strongly cemented caliche		
Gila (GbA, GcA, GcB, GeA, GfA, GgA). (For properties of the Glendale soil in mapping unit GgA, refer to the Glendale series in this table.)	0–60	Loam to silt loam (surface soil gravelly in places).	CL or ML	A–4 or A–6
Glendale (Gm, Gn, Go, Gp).	0–60	Clay loam to silty clay loam	CL	A–6
Grabe (Gr, Gs, Gt).	0–66	Loam to very fine sandy loam.	ML to CL	A–4
Graham (GuE).	0–14	Gravelly clay loam and gravelly clay.	CL	A–6
	14–16	Bedrock—fractured.		
Guest (Gy).	0–56	Clay or clay loam	CL or CH	A–6 or A–7
Maricopa (Ma, Mr).	0–26	Sandy loam	SM	A–2 or A–4
	26–48	Very gravelly sand to gravelly sandy loam.	GP–GM	A–1
Pima (Pa, Pc, Pe, Pm).	0–60	Clay loam (clay surface soil in places).	CL	A–6

and qualities of the soils

variable, and their properties were not estimated; absence of data indicates properties were not estimated]

Percentage passing sieve—			Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential
No. 4 (4.76 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)					
			Inches per hour	*Inches per inch of soil*	*pH*	*Mmhos/cm.*	
100	95–100	60–70	0.63–2.0	0.16–0.18	7.9–8.4	0–2	Low.
40–50	35–45	5–15	20.0	0.05–0.07	7.9–8.4	0–2	Low.
98–100	80–95	30–50	2.0–6.3	0.09–0.13	7.9–8.4	0–4	Low.
35–55	30–50	10–20	6.3–20.0	0.05–0.07	7.4–8.4	0–2	Low.
95–100	90–100	20–50	0.63–2.0	0.08–0.18	7.4–8.4	0–2	Low.
40–50	30–40	5–15	>20.0	0.05–0.07	7.9–8.4	0–2	Low.
98–100	80–90	25–35	0.63–2.0	0.10–0.12	7.9–8.4	4–16	Low.
95–100	90–100	30–50	0.63–2.0	0.10–0.18	7.4–8.4	0–2	Low.
90–100	90–100	0–5	>20.0	0.05–0.07	7.9–8.4	0–2	Low.
90–100	55–65	25–45	0.63–6.3	0.08–0.13	7.4–8.4	0–2	Low.
------	------	------	<0.063	------	7.9–8.4	------	
80–90	40–50	10–20	2.0–6.3	0.06–0.08	6.6–7.8	0–2	Low.
90–100	90–100	30–45	0.63–6.3	0.12–0.14	7.9–8.4	0–4	Low to moderate.
80–90	70–90	50–65	0.2–0.63	0.10–0.15	6.6–8.4	0–2	Moderate.
------	------	------	<0.063	------	7.9–8.4	------	
98–100	95–100	75–85	0.63–2.0	0.16–0.21	7.9–8.4	0–4	Low to moderate.
98–100	100	85–95	0.2–0.63	0.19–0.21	7.9–8.4	0–16	Moderate.
100	95–100	75–85	0.63–2.0	0.13–0.18	7.9–8.4	0–8	Low.
75–85	60–70	50–60	0.063–0.63	0.10–0.14	7.4–8.4	0–2	Moderate.
100	100	95–100	0.063–0.2	0.14–0.20	7.9–8.4	0–4	Moderate to high.
98–100	80–95	30–45	2.0–6.3	0.10 0.14	7.9–8.4	0–4	Low.
40–50	35–45	5–15	20.0	0.05–0.07	7.9–8.4	0–2	Low.
100	95–100	85–95	0.2–0.63	0.18–0.21	7.9–8.4	0–16	Moderate.

TABLE 4.—*Estimated engineering properties*

Soil series and map symbol	Depth	Classification		
		Dominant USDA texture	Unified	AASHO
	Inches			
Pinaleno (PnB, PrB, PsB, PuB, PvC). (For properties of Bitter Spring soil in mapping unit PsB, of Cave soil in mapping unit PuB, and of Continental soil in mapping unit PvC, refer to the respective series in this table.)	0–30 30–45	Very gravelly clay loam Very gravelly and cobbly lime hardpan.	GP–GC	A–2
Tidwell (TdB, TeA, TgA). (For properties of the Gila and of the Glendale soils in mapping unit TgA, refer to the respective series in this table.)	0–16 16–50	Sandy loam to loam Sandstone and clay shale—stratified.	SM or SC ----------	A–2, A–4 ----------
Tres Hermanos (ThC). (For properties of Bitter Spring soil in this mapping unit, refer to the Bitter Spring series in this table.)	0–11 11–55	Sandy clay loam Gravelly sandy loam	ML to CL SM	A–4 or A–6 A–2
Whitlock (WhA, WkA, WkB).	0–29 29–54	Sandy loam Sand	SM SP	A–4 A–3

TABLE 5.—*Interpretations of engineering*

Soil series and map symbols	Suitability as a source of—[1]				Soil features affecting engineering practices for—
	Topsoil	Sand	Gravel	Road fill	Highway location
Aqua (Ac, Ag)	Good to poor	Fair for fine to coarse sand.	Fair for fine and coarse gravel.	Fair to good	Cut slopes erodible.
Anthony (AhA, AlB, AmA, AnA, ApB, AtA). (For properties of Continental and Pinaleno soils in mapping unit ApB, refer to their respective series.)	Fair	Fair for fine sand.	Fair for fine and coarse gravel.	Good	Cut slopes erodible.
Arizo:					
(AuA, AwA)	Fair	Fair for medium and coarse sand.	Good for fine and coarse gravel.	Good	Features favorable.
(AvA, AvB, AzA)	Poor or not suited.	Fair for medium and coarse sand.	Good for fine and coarse gravel.	Good	Features favorable.

See footnotes at end of table.

and qualities of the soils—Continued

Percentage passing sieve— No. 4 (4.76 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)	Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential
			Inches per hour	*Inches per inch of soil*	*pH*	*Mmhos/cm.*	
20–30	15–25	5–15	0. 2–2. 0 <0. 063	0. 06–0. 08	7. 9–8. 4 7. 9–8. 4	0–2	Low.
98–100	90–100	25–45	0. 63–6. 3	0. 10–0. 18	7. 9–8. 4 7. 9–9. 0	0–4	Low.
98–100 90–100	85–95 55–65	50–60 25–35	0. 2–0. 63 2. 0–6. 3	0. 14–0. 16 0. 07–0. 13	7. 9–8. 4 7. 9–8. 4	0–8 2–8	Moderate. Low.
95–100 90–100	85–95 80–90	35–45 5–15	2. 0–6. 3 >20. 0	0. 10–0. 12 0. 05–0. 07	7. 9–8. 4 7. 9–8. 4	0–4 0–4	Low. Low.

properties of soils

Soil features affecting engineering practices for—Continued: Dikes (uncompacted)	Farm ponds: Reservoir area	Farm ponds: Embankments (compacted)	Irrigation	Foundations for low buildings	Limitations for use as septic tank filter fields
Moderate to moderately low shear strength; moderate permeability; moderately low stability; sand and gravel below a depth of 24 inches.	Moderate permeability; sand and gravel below a depth of 24 inches.	Moderate to moderately low shear strength; slow permeability; moderately low stability; good to fair compaction characteristics; sand and gravel below a depth of 24 inches.	Moderate permeability; good water-holding capacity above 24 inches, low below 24 inches; sand and gravel below a depth of 24 inches.	Moderate to moderately low shear strength; low shrink-swell potential.	Slight:[2] Moderate permeability; sand and gravel below a depth of 24 inches.
Moderate shear strength; moderately rapid permeability; moderate stability.	Moderately rapid permeability.	Moderate shear strength; moderate permeability; moderate stability; good compaction characteristics.	Moderately rapid permeability; fair water-holding capacity.	Moderate shear strength; low shrink-swell potential.	Slight:[2] Moderately rapid permeability.
High shear strength; very rapid permeability; moderately high stability.	Very rapid permeability below the surface layer.	High shear strength; rapid permeability; moderately high stability; good compaction characteristics.	Very rapid permeability; low water-holding capacity.	High shear strength; low shrink-swell potential.	Slight:[2] Very rapid permeability.
High shear strength; very rapid permeability; moderately high stability.	Very rapid permeability below the surface layer.	High shear strength; rapid permeability; moderately high stability; good compaction characteristics.	Very rapid permeability; low water-holding capacity.	High shear strength; low shrink-swell potential.	Slight:[2] Very rapid permeability.

TABLE 5.—*Interpretations of engineering*

Soil series and map symbols	Suitability as a source of— [1]				Soil features affecting engineering practices for—
	Topsoil	Sand	Gravel	Road fill	Highway location
Bitter Spring (BeB, BpB) (For properties of Pinaleno soil in mapping unit BpB, refer to the Pinaleno series.)	Poor	Not suited	Not suited	Good	Cut slopes erodible.
Brazito (Br, Bt)	Fair	Good for medium and coarse sand.	Poor	Good	Subject to soil blowing.
Cave (ChB, ChE, CkD) (For properties of Pinaleno soil in mapping unit CkD, refer to the Pinaleno series.)	Poor	Not suited	Not suited	Good	Cemented caliche below a depth of 5 to 14 inches.
Cellar (ClF)	Poor	Not suited	Not suited	Good	Bedrock below a depth of 5 to 14 inches.
Comoro (Cm, Cn, Co)	Good to fair	Fair for fine sand.	Poor	Good	Cut slopes erodible; subject to soil blowing.
Continental (CrB, CsB, CtB) (For properties of Gila soil in mapping unit CsB and for properties of Pinaleno soil in mapping unit CtB, refer to their respective series.)	Poor	Not suited	Poor	Poor	Lime-cemented cobblestones and gravel below a depth of 24 inches.
Gila (GbA, GcA, GcB, GeA, GfA, GgA) (For properties of Glendale soil in mapping unit GgA, refer to the Glendale series.)	Good	Fair for fine sand.	Poor	Fair to poor	Cut slopes erodible.
Glendale (Gm, Gn, Go, Gp)	Poor	Not suited	Not suited	Poor to fair	Moderately plastic; cut slopes erodible.

See footnotes at end of table.

properties of soils—Continued

Soil features affecting engineering practices for—Continued					Limitations for use as septic tank filter fields
Dikes (uncompacted)	Farm ponds		Irrigation	Foundations for low buildings	
	Reservoir area	Embankments (compacted)			
Moderate shear strength; moderate permeability; moderate stability.	Moderate permeability.	Moderate shear strength; moderate permeability; moderate stability; good compaction characteristics.	Moderate permeability; low water-holding capacity; high content of lime.	Moderate shear strength; low shrink-swell potential.	Slight: Moderate permeability.
High shear strength; very rapid permeability; moderate stability.	Very rapid permeability below the surface layer.	High shear strength; rapid permeability; moderately high stability; good compaction characteristics.	Very rapid permeability; low water-holding capacity.	High shear strength; low shrink-swell potential.	Slight:[2] Very rapid permeability.
Cemented caliche below a depth of 5 to 14 inches; moderate shear strength; moderate stability.	Cemented caliche below a depth of 5 to 14 inches.	Cemented caliche below a depth of 5 to 14 inches; moderate shear strength.	Not suited	High shear strength; low shrink-swell potential.	Severe: Cemented caliche below a depth of 5 to 14 inches.
Bedrock below a depth of 5 to 14 inches; moderate shear strength; moderately rapid permeability; moderate stability.	Bedrock below a depth of 5 to 14 inches.	Bedrock below a depth of 5 to 14 inches; moderate shear strength; moderately rapid permeability; good compaction characteristics.	Not suited	Moderate shear strength; low shrink-swell potential.	Very severe:[3] Bedrock below a depth of 5 to 14 inches.
Moderate shear strength; moderately rapid permeability; moderate stability.	Moderately rapid permeability below the surface layer.	Moderate shear strength; moderate permeability; moderate stability; good compaction characteristics.	Moderately rapid permeability; fair water-holding capacity.	Moderate shear strength; low shrink-swell potential.	Slight:[2] Moderately rapid permeability.
Moderate shear strength; moderately slow permeability; moderate stability.	Moderately slow permeability; lime cemented cobblestones and gravel below a depth of 24 inches.	Moderate shear strength; slow permeability; moderate stability; fair compaction characteristics.	Moderately slow permeability; good water-holding capacity; gravelly surface layer.	Moderate shear strength; moderate shrink-swell potential.	Severe: Moderately slow permeability; lime-cemented cobblestones and gravel below a depth of 24 inches.
Moderate to moderately low shear strength; moderate permeability: moderately low stability.	Moderate permeability.	Moderate to moderately low shear strength; slow permeability; moderately low stability; good to fair compaction characteristics.	Moderate permeability; high water-holding capacity.	Moderate to moderately low shear strength; low to moderate shrink-swell potential.	Slight to moderate: Moderate permeability.
Moderately low shear strength; moderately slow permeability; moderately low stability; subject to piping.	Moderately slow permeability.	Moderately low shear strength; slow permeability; moderately low stability; fair compaction characteristics; subject to piping.	Moderately slow permeability; good water-holding capacity; saline in places.	Moderately low shear strength; moderate shrink-swell potential.	Severe: Moderately slow permeability.

TABLE 5.—*Interpretations of engineering*

Soil series and map symbols	Suitability as a source of— [1]				Soil features affecting engineering practices for—
	Topsoil	Sand	Gravel	Road fill	Highway location
Grabe (Gr, Gs, Gt)	Good	Fair for fine sand.	Not suited	Fair	Cut slopes erodible
Graham (GuE)	Poor	Not suited	Not suited	Poor	Bedrock below a depth of 8 to 20 inches.
Gravelly alluvial land (Gv)	Poor or not suited.	Fair for fine to coarse sand.	Fair	Good	Features favorable
Guest (Gy)	Poor or not suited.	Not suited	Not suited	Poor	Plastic; moderate to high shrink-swell potential.
Maricopa (Ma, Mr)	Fair	Fair for fine sand.	Fair for fine and coarse gravel.	Good	Cut slopes erodible.
Pima (Pa, Pc, Pe, Pm)	Poor or not suited.	Not suited	Not suited	Poor	Plastic
Pinaleno (PnB, PrB, PsB, PuB, PvC) (For properties of Bitter Spring soil in mapping unit PsB; for properties of Cave soil in mapping unit PuB; and for properties of Continental soils in mapping unit PvC, refer to their respective series.)	Fair	Not suited	Fair	Good	Lime-cemented cobblestones and gravel below a depth of 30 inches.
Riverwash (Rh)	Fair	Fair for fine to coarse sand.	Fair for fine or coarse gravel and cobblestones.	Good	Subject to flooding

See footnotes at end of table.

properties of soils—Continued

Soil features affecting engineering practices for—Continued						Limitations for use as septic tank filter fields
Dikes (uncompacted)	Farm ponds: Reservoir area	Farm ponds: Embankments (compacted)	Irrigation	Foundations for low buildings		
Moderate to moderately low shear strength; moderate permeability; moderately low stability.	Moderate permeability.	Moderate to moderately low shear strength; slow permeability; moderately low stability; good to fair compaction characteristics.	Moderate permeability; good water-holding capacity.	Moderate to moderately low shear strength; low shrink-swell potential.		Slight to moderate: Moderate permeability.
Low shear strength; moderately slow to slow permeability; low stability; moderate shrink-swell potential.	Bedrock below a depth of 8 to 20 inches.	Low shear strength; slow permeability; low stability; moderate shrink-swell potential.	Not suited	Low shear strength; moderate shrink-swell potential.		Very severe:[3] Bedrock below a depth of 12 to 20 inches.
Moderate to high shear strength; moderately rapid to rapid permeability; moderate to moderately high stability.	Moderately rapid to rapid permeability.	Moderate to high shear strength; rapid permeability; moderate to moderately high stability; good compaction characteristics.	Not suited	Moderate to high shear strength.		Slight:[2] Moderately rapid to rapid permeability.
Moderately low shear strength; slow permeability; moderate to high shrink-swell potential; moderately low stability.	Slow permeability	Moderately low shear strength; slow permeability; moderately low stability; good to fair compaction characteristics.	Slow permeability; good water-holding capacity.	Moderately low shear strength; moderate to high shrink-swell potential.		Very severe:[3] Slow permeability.
Moderate shear strength; moderately rapid permeability; moderate stability.	Moderately rapid permeability.	Moderate shear strength; moderate permeability; moderate stability; good compaction characteristics.	Moderately rapid permeability; fair water-holding capacity.	Moderate shear strength; low shrink-swell potential.		Slight:[2] Moderately rapid permeability.
Moderately low shear strength; moderately slow permeability; moderately low stability; moderate to high shrink-swell potential.	Moderately slow permeability.	Moderately low shear strength; slow permeability; moderately low stability; good to fair compaction characteristics.	Moderately slow permeability; good water-holding capacity.	Moderately low shear strength; moderate to high shrink-swell potential.		Severe: Moderately slow permeability.
Moderate shear strength; very slow permeability; moderate stability; low shrink-swell potential.	Very slow permeability; lime-cemented cobblestones and gravel below a depth of 30 inches.	Moderate shear strength; slow permeability; moderate stability; low to moderate shrink-swell potential.	Very slow permeability; good water-holding capacity.	Moderate shear strength; low shrink-swell potential.		Severe: Very slow permeability; lime-cemented cobblestones and gravel below a depth of 30 inches.
High shear strength; very rapid permeability; low shrink-swell potential.	Very rapid permeability.	High shear strength; rapid permeability; low shrink-swell potential.	Not suited	High shear strength; subject to flooding.		Very severe:[3] Very rapid permeability; flooding.

TABLE 5.—*Interpretations of engineering*

Soil series and map symbols	Suitability as a source of— [1]				Soil features affecting engineering practices for—
	Topsoil	Sand	Gravel	Road fill	Highway location
Rock land (Rk)	Not suited	Not suited	Not suited	Poor or not suited.	Bedrock at a depth of 0 to 6 inches.
Rough broken land (Ro)	Poor or not suited.	Poor or not suited.	Poor or not suited.	Poor to good	Steep slopes; deep cuts and high fills; highly erodible in places.
Tidwell (TdB, TeA, TgA) (For properties of Gila and Glendale soils in mapping unit TgA, refer to their respective series.)	Fair	Poor	Not suited	Good	Weak bedrock below a depth of 6 to 24 inches.
Tres Hermanos (ThC) (For properties of Bitter Spring soil in mapping unit ThC, refer to the Bitter Spring series.)	Poor	Not suited	Not suited	Good	Subject to soil blowing.
Whitlock (WhA, WkA, WkB)	Fair	Fair for fine to coarse sand.	Poor	Fair to good	Cut slopes erodible.

[1] Based on that part of profile best suited.
[2] Coarse-textured material in subsoil or overflow may allow contamination of water supply.
[3] Arizona Revised Statute, Title 36, Chapter 2, Sections 36-132, Article 2, Part III states that these soils are unsuitable for septic tank filter fields.

properties of soils—Continued

Soil features affecting engineering practices for—Continued						Limitations for use as septic tank filter fields
Dikes (uncompacted)	Farm ponds		Irrigation	Foundations for low buildings		
	Reservoir area	Embankments (compacted)				
Bedrock at a depth of 0 to 6 inches.	Bedrock	Bedrock	Not suited	Bedrock; moderate shear strength; low shrink-swell potential.		Very severe: [3] Bedrock.
Variable shear strength, permeability, and stability; subject to piping; moderate to low shrink-swell potential.	Variable permeability; moderate to low shrink-swell potential.	Variable shear strength, stability, and compaction; good compaction characteristics.	Not suited	Moderate to low shrink-swell potential.		Severe or very severe: [4] Slow to rapid permeability; steep slopes.
Moderate shear strength; moderately rapid to moderate permeability; low shrink-swell potential.	Sandstone bedrock below a depth of 6 to 24 inches; has moderate permeability.	Moderate shear strength; moderate to slow permeability; moderate stability; fair compaction characteristics.	Poorly suited	Moderate shear strength; low shrink-swell potential.		Very severe: [3] Bedrock below a depth of 6 to 20 inches.
Moderate shear strength; moderate stability; moderately rapid permeability below a depth of 11 inches.	Moderately rapid permeability below a depth of 11 inches.	Moderate shear strength; moderate stability; moderate permeability; good compaction characteristics.	Fair water-holding capacity; moderately rapid permeability below a depth of 11 inches.	Moderate shear strength; low to moderate shrink-swell potential.		Slight: Moderately rapid permeability below a depth of 20 inches.
Moderate shear strength; moderately rapid permeability; moderate stability.	Moderately rapid permeability below the surface layer.	Moderate shear strength; moderate permeability; moderate stability; good compaction characteristics.	Moderately rapid permeability; fair water-holding capacity.	Moderate shear strength; low shrink-swell potential.		Slight: Moderately rapid permeability.

[4] Areas that have very severe limitations for use as septic tank filter fields would be rated unsuitable, according to statute referred to in footnote 3.

The degree of salinity in table 4 refers to the approximate salt content of soils. Determinations are based on the electrical conductivity of saturated soil extract, and the results are expressed in millimhos per centimeter (mmhos/cm.) at 25° C. These results are explained in the Glossary. Salinity affects the stability of soils when used in construction and the rate of corrosion of materials placed in the soils.

The shrink-swell potential is an indication of the volume change to be expected in a soil as the moisture content changes. This potential is rated *low*, *moderate*, and *high*. Guest clay, for example, swells and is very plastic and sticky when wet; and when it dries it shrinks and moderately extensive cracks develop. The shrink-swell potential of this soil is rated very high. Generally, the higher the shrink-swell potential of the soil the more difficult is the maintenance of the structures built on that soil.

Depth to a seasonal high water table is not given in table 4, because a water table occurs in only a few local areas in soils in alluvium. When present, the water table fluctuates with the season and seldom is detrimental. Depth to bedrock is not given, because only the Cellar, Graham, and Tidwell soils are shallow to bedrock. Bedrock is at a depth of 9 inches in the Cellar soils, 14 inches in the Graham soils, and 16 inches in the Tidwell soils.

Engineering interpretations of soils

In table 5 soils are rated for suitability as a source of topsoil, sand, gravel, and road fill. Also shown are features affecting highway location, dikes, farm ponds, and irrigation and some limitations to use for septic tank filter fields and foundations for low buildings. These interpretations are based on information given in table 4, on field experience, and on observed performance of soils.

The ratings of soils as a source of topsoil, sand, gravel, and road fill are based on that part of the profile most suited. The soils are rated *good*, *fair*, *poor*, and *not suited*. Suitability for road fill is based largely on texture and plasticity. The Pima, Guest, and Continental soils have a high clay content and are very plastic; consequently, these soils are rated poor for road fill.

For features that affect engineering practices, the entire soil profile was evaluated. The features mainly considered were depth to bedrock, erodibility, permeability, compaction characteristics, shear strength, and stability.

Limitations to the use of soils for septic tank filter fields and foundations are given in table 5. The main limitations to these uses are depth to bedrock or other restricting layer, permeability, flooding, and slope.

Formation and Classification of Soils

This section tells how the factors of soil formation affected the development of soils in the Safford Area. The current system of soil classification is explained, and each soil series is placed in some classes of this system, as well as in the great soil group in the older system used in 1938 and later revised.

Factors of Soil Formation

Soil is the product of soil-forming processes acting on accumulated or deposited geologic material. The five important factors in soil formation are time, relief, parent material, climate, and living organisms. These factors control the kind of soil-forming processes and the rate at which they progress. All five factors are active in the formation of every soil, though one factor may be more active than the others. In the Safford Area, the effect of climate and living organisms on parent material is restricted by desert conditions. The effects of time and relief on parent material are more important.

Time

The kind of horizons and the degree of their development depend in part on the length of time that the other factors have been active.

The lowest degree of horizonation is in soils that formed in alluvium. Examples are the Comoro and Gila soils. These soils are flooded periodically and receive additional sediment with each flood. They also receive sediment from silt-laden water used for irrigation. Some soils have been formed from this sediment, and some have been formed by leveling areas for irrigation. These soils are very young. Organic matter has accumulated in the surface layer or has been added in farming and has formed an A horizon, but further differentiation of horizons has not occurred. The C horizon in many soils formed in alluvium is stratified.

The Bitter Spring soils are on low geologic terraces above the inner valley. These soils are older and better developed than those formed on flood plains. They have a thin A horizon and a B horizon with more clay than the A horizon. A strong layer of accumulated lime is within 2 feet of the surface, and the horizons above are calcareous. The accumulated lime, as well as the clay content of the B horizon, indicates that these soils are older than the soils in the more recently deposited alluvium on flood plains.

Soils in the survey area that reflect the highest degree of horizonation for the longest period of time are the Continental soils. These soils are on the older geologic terraces above the Bitter Spring soils. On the highest, or oldest, terrace, Continental soils have an A horizon and a thick, clayey B horizon that are deeply leached of lime. On the middle terraces, these soils have the same horizons, but the lime is less deeply leached and the B horizon is not so thick as it is in the soils on the higher, older terraces. This range in the depth of leaching and the accumulation of clay in the B horizon indicate both the age of the soils and the amount of water that has moved downward through them. The Continental soils may have formed, in part, in a climate that was more moist than the climate is now. These soils have been forming longer than most other soils in the Safford Area.

Relief

Relief, or lay of the land, influences soil formation because of its effect on moisture, temperature, and erosion. The inner valley along the Gila River and its tributaries include most of the soils formed in recently deposited sediment. Elevations range from 2,600 to about 3,200 feet, and the surface is fairly smooth. Except where

these soils are dissected by washes or gullies, they generally receive deposits of sediment each year. Because of their position in the landscape and the age of the parent material, the Grabe, Gila, Comoro, and other soils have developed only an A horizon. The C horizon in these soils consists of stratified parent material. The low terraces above the irrigated soils are older geologically than the inner valley, and each succeeding higher terrace is older than the one below. The highest terrace, therefore, is the oldest one in the survey area. Elevations of these terraces range from 2,700 to 4,000 feet. The surface of the terraces is smooth, and slopes generally are gentle. Streams and washes have cut into the terraces and formed steep-walled canyons.

Continental soils are on the higher terraces. At lower elevations the soil material is more recent, the effective rainfall is less, and the soils have less horizonation. An example is the Bitter Spring soils.

The depth of soils forming from weathered rock, such as the Graham and Cellar soils, depends partly on relief. In general, the steeper the slope the shallower the soil. When the soils are very steep or the rate of geologic erosion is rapid, the material weathered from rocks does not remain in place long enough for soil to form. In these areas outcrops of rock are common.

Parent material

All soils in the Safford Area, except the Cellar, Graham, and Tidwell soils, formed in transported parent material. These soils formed in place from weathered rock.

The dominant source of transported parent material is the mountains on either side of the valley along the Gila River. The Pinaleno Mountains on the south side are chiefly granitic, and the Gila Mountains on the north side are mainly rhyolitic. The secondary source of transported parent material is alluvium deposited by the Gila River. This alluvium is mixed and varies in size of particles and in mineral composition. Most of the alluvium has been transported for great distances. The chief area of deposition of the mixed alluvium is the inner valley along the flood plain of the Gila River. In some places the materials from the dominant and secondary sources are mixed, but this mixing has little influence on the formation of soils in the area.

All soils in the survey area, except the Cellar soils, show the influence of lime (alkaline earth carbonates). The Bitter Spring, Cave, Tres Hermanos, and Whitlock soils developed in materials containing large amounts of carbonates. Although enough lime has been leached downward to form a layer of accumulated lime in these soils, they are calcareous throughout.

Climate

Climate strongly affects the kind of vegetation, the rate at which organic matter decomposes, the rate at which minerals weather, and the removal or accumulation of materials in different soil horizons.

The climate of the Safford Area ranges from warm arid to warm semiarid, but most of the area is arid. The average annual rainfall is less than 9 inches. The warmer, drier parts are in or adjacent to the inner valley. As the elevation increases, precipitation increases and temperature decreases. The difference is slight, but it's great enough that two kinds of climate are recognized.

Under the prevailing climate, soils that developed in parent material low in lime are slightly leached of carbonates. The depth to which the carbonates are leached depends on the amount of water that has moved downward through the soil. The amount of water that moves into and through the soil depends on the amount of rainfall and the length of time the soil is exposed to rainfall. For example, Continental soils that are on the higher, older terraces are more deeply leached of carbonates than the Continental soils on the lower, more recent terraces. The difference in depth of leaching indicates that more water has moved through the soils on the higher terraces. These soils on older terraces have been exposed longer, and they receive a little more precipitation than soils on the more recent terraces.

The soils in recently deposited alluvium that have a sandy surface layer are leached of lime to a depth of about 4 to 6 inches. There is no accumulation of lime in these soils. The soils in alluvium that have a loam or clay loam surface layer seldom are leached of lime to a depth of more than 1 to 2 inches. Soils irrigated with water that contains carbonates are calcareous throughout.

Because the climate is warm and dry, most of the unirrigated soils in the Safford Area contain only a small amount of organic matter in the surface layer. In cultivated soils man has added some organic matter to the plowed layer. These cultivated soils hold more water and have a cooler temperature than soils that have less organic matter. This cooler temperature slows the rate of decomposition of the organic matter.

Climate largely controls the natural vegetation that grows in the survey area. By using irrigation water on large acreages, man has increased the amount of moisture available to plants, increased the humidity in the air over fields, and lowered the temperature of the soil through evaporation.

Living organisms

Living organisms (plants and animals) that live in and on the soil are important in soil formation. The higher order of plants include trees, shrubs, and grasses; animals include earthworms, gophers, badgers, and other burrowing animals as well as man; and micro-organisms include fungi, algae, bacteria, and other microscopic plants and animals. Because man has changed some of the climatic conditions by irrigating a large acreage, he has changed some of the natural soil-forming processes. By introducing grazing animals, he has reduced the amount of vegetation on the soils. Man has increased the organic-matter content of the Pima, Grabe, and other soils that he has farmed over those not farmed. The activity of living organisms is of less importance in soil formation than the other factors, except in places where man has changed climatic conditions by irrigating large areas.

Classification of Soils

Soils are classified so that we may more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their

relationship to one another and to the whole environment, and to develop principles that help us understand their behavior and their response to manipulation. First through classification, and even through the use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

Thus in classification, soils are placed in narrow categories that are used in detailed soil surveys so that knowledge about the soils can be organized and applied in managing farms, fields, and woodland; in developing rural areas; in engineering works; and in many other ways. They are placed in broad classes to facilitate study and comparison in large areas, such as countries and continents.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (*2*) and later revised (*9*). The system currently used was adopted for general use by the National Cooperative Soil Survey in 1965. The current system is under continual study (*10*, *7*). Therefore, readers interested in developments of this system should search for the latest literature available. In table 6, classes in the current system and the great soil groups in the older system are given for each soil series. The classes in the current system are briefly defined in the following paragraphs. A description of each soil series in the survey area, including a profile representative of a soil in that series, can be found in the section "Descriptions of the Soils."

ORDER: Ten soil orders are recognized in the current system. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate the soil orders are those that tend to give broad climatic groupings of soils. Two exceptions, Entisols and Histosols, occur in many different climates.

Table 6 shows the three soil orders in the Safford Area—Entisols, Aridisols, and Mollisols. Entisols are recent soils. They are without genetic horizons or have only the beginnings of such horizons. Aridisols are soils that have a light-colored surface horizon, are low in organic matter, and are dry most of the time. Mollisols are soils that have thick surface layers that are dark, friable, and soft, that contain more than 1 percent organic matter, and that have a high base supply.

SUBORDER: Each order is subdivided into suborders, primarily on the basis of those characteristics that seem to produce classes having the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders mainly reflect either the presence or absence of waterlogging or soil differences resulting from the climate or vegetation.

GREAT GROUPS: Soil suborders are separated into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus have accumulated or those that have pans interfering with growth of roots or movement of water. The features used are the self-mulching properties of clay, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), and the like. The great group is not shown separately in table 6 because it is the last word in the name of subgroup.

TABLE 6.—*Soil series classified according to the current system of classification and the revised 1938 system*

Series	Current classification			1938 classification
	Family	Subgroup	Order	Great soil group
Agua	Coarse-loamy over sandy or sandy-skeletal, mixed, calcareous, thermic.	Typic Torrifluvents	Entisols	Alluvial soils.
Anthony	Coarse-loamy, mixed, calcareous, thermic	Typic Torrifluvents	Entisols	Alluvial soils.
Arizo	Sandy-skeletal, mixed, nonacid, thermic	Typic Torriorthents	Entisols	Alluvial soils.
Bitter Spring	Coarse-loamy, mixed, thermic	Typic Haplargids	Aridisols	Desert soils.
Brazito	Sandy, mixed, nonacid, thermic	Typic Torripsamments.	Entisols	Alluvial soils.
Cave	Loamy, mixed, thermic, shallow	Typic Paleorthids	Aridisols	Calcisols.
Cellar	Loamy-skeletal, mixed, nonacid, thermic	Lithic Torriorthents	Entisols	Lithosols.
Comoro	Coarse-loamy, mixed, thermic	Cumulic Haplustolls	Mollisols	Alluvial soils.
Comoro, mottled variant.	Coarse-loamy, mixed, thermic	Aquic Fluventic Haplustolls.	Mollisols	Alluvial soils.
Continental	Fine, mixed, thermic	Typic Haplargids	Aridisols	Reddish Brown soils.
Gila	Coarse-loamy, mixed, calcareous, thermic	Typic Torrifluvents	Entisols	Alluvial soils.
Glendale	Fine-silty, mixed, calcareous, thermic	Typic Torrifluvents	Entisols	Alluvial soils.
Grabe	Coarse-loamy, mixed, thermic	Cumulic Haplustolls	Mollisols	Alluvial soils.
Graham	Clayey, montmorillonitic, thermic	Lithic Argiustolls	Mollisols	Reddish Chestnut soils.
Guest	Fine, mixed, thermic	Fluventic Haplustolls.	Mollisols	Alluvial soils.
Maricopa	Coarse-loamy over sandy or sandy-skeletal, mixed, calcareous, thermic.	Typic Torrifluvents	Entisols	Alluvial soils.
Pima	Fine-silty, mixed, thermic	Fluventic Haplustolls.	Mollisols	Alluvial soils.
Pinaleno	Loamy-skeletal, mixed, thermic	Typic Haplargids	Aridisols	Red Desert soils.
Tidwell	Loamy, mixed, calcareous, thermic	Lithic Torriorthents	Entisols	Lithosols.
Tres Hermanos	Fine-loamy, mixed, thermic	Typic Haplargids	Aridisols	Red Desert soils.
Whitlock	Coarse-loamy, mixed, thermic	Typic Calciorthids	Aridisols	Calcisols.

SUBGROUP: Great groups are subdivided into subgroups, one representing the central (typic) segment of the group and others, called intergrades, that have properties of one great group and also one or more properties of another great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group. An example is *Typic Haplargids*.

FAMILY: Families are separated within a subgroup primarily on the basis of properties important to the growth of plants or behavior of soils where used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, and thickness of horizons. An example is *fine-loamy, mixed, thermic* family of Typic Haplargids.

Laboratory Analyses

The results of laboratory analyses of samples taken, by horizons, from selected soil profiles are shown in table 7. The samples were analyzed and the determinations made at the Soils Laboratory of the Arizona Agricultural Experiment Station in Tucson, Ariz., between March 1958 and April 1963. The analyses were made according to procedures described in the U.S. Department of Agriculture Handbook No. 60 (*11*). The profiles of Cave gravelly sandy loam, Graham extremely rocky clay loam, and Pima clay loam are described in the section "Descriptions of the Soils," but the rest of the profiles are not described in this soil survey.

TABLE 7.—*Laboratory analyses of selected soils*

Soil	Horizon	Depth from surface	Reaction		Electrical conductivity ($ECx10^3$)	Organic matter	Calcium carbonate equivalent	Mechanical analysis [1]			
			Paste	1:5 suspension				Sand	Silt	Clay	Gravel
		Inches	*pH*	*pH*	*Mmhos. per cm. at 25° C.*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Anthony sandy loam.	Ap, C1	0–9	7.9	8.2	2.4	0.96	4	70	22	8	11.6
	C1	9–20	8.1	8.5	2.0	.22	8	58	30	12	2.3
	C1, C2	20–48	7.8	8.1	5.8	(2)	3	56	30	14	1.6
Bitter Spring gravelly sandy loam.	A11	0–½	7.8	8.1	.95	.33	2	57	33	10	15.8
	A12	½–2	7.9	8.2	.95	.19	3	62	26	12	15.5
	B2t	2–22	7.9	8.6	1.7	.88	7	43	33	24	49.4
	C1ca, C2ca	22–36	8.2	9.0	10.0	.17	23	62	29	9	3.9
Cave gravelly sandy loam.	A11	0–2	7.5	8.0	.78	.35	1	58	35	7	12.1
	A12	2–7	7.9	8.1	.65	.25	3	65	29	6	19.7
	C1ca	7–12	7.8	8.2	.65	.50	18	51	31	13	25.1
	C2cam	12–24	(3)	(3)							
Continental gravelly sandy loam.	A1	0–3	7.3	7.5	.6	.95	3	57	27	16	30.4
	B21t	3–7	6.9	7.0	.65	.91	2	48	24	28	31.0
	IIB22t	7–16	7.5	7.8	.47	.67	2	29	16	55	11.6
	IIIB23tca	16–27	7.8	8.1	.8	.85	5	29	18	53	31.8
	IVCcam	27–48	(3)	(3)							
Grabe clay loam.	Ap	0–10	7.7	8.7	1.4	1.52	(2)	26	38	36	0
	C	10–48	7.7	8.7	3.8	.64	(2)	39	34	27	2.7
Graham extremely rocky clay loam.[4]	A1	0–1	6.4	6.6	.78	2.41	1	27	39	34	(2)
	B21t	1–6	7.0	7.3	.6	1.45	1	22	35	43	(2)
	B22t	6–14	7.6	8.0	.5	1.32	2	17	28	55	(2)
	R	14	(5)								
Guest clay.	Ap	0–10	7.8	8.2	2.0	1.8	7	24	35	41	0
	C1	10–36	7.9	8.2	3.6	(2)	12	19	36	45	0
	C2	36 60	8.1	8.5	1.5	(2)	15	16	37	47	0
Pima clay loam.[4]	Ap1	0–12	7.9	8.3	5.2	1.2	8	17	51	32	0
	Ap2	12–18	7.8	8.3	7.2	.7	13	17	50	33	0
	C1	18–42	7.7	8.1	10.8	.4	13	16	50	34	0
	C2	42–60	7.9	8.4	5.5	.2	15	16	40	44	0

[1] The hydrometer method was used in making this analysis. The percentages of sand, silt, and clay are the percentages of the material less than 2 millimeters in diameter. The percentage of the gravel is the percentage of the total sample.

[2] Not determined.

[3] Lime-cemented hardpan.

[4] Profile described in the section "Descriptions of the Soils."

[5] Bedrock.

General Nature of the Area

This section was prepared mainly for those who want general information about the Safford Area. Geology, relief, and drainage; climate; forming; and other subjects of general interest are briefly discussed.

Geology, Relief, and Drainage [5]

The valley of the Gila River, known to geologists as the Safford Basin, is a northwest trending, intermontane trough 15 miles wide by 60 miles long. This trough is bounded by the Pinaleno and Santa Teresa Mountains on the southwest and by the Gila Mountains on the northeast. Elevations in the basin range from 2,600 to about 4,000 feet above sea level, but the elevation of Mount Graham in the Pinaleno Mountains is 10,713 feet. Elevations in the Gila Mountains range from 4,000 to 6,000 feet.

The Safford Basin has been filled by as much as 3,000 feet of sediment derived almost entirely from the surrounding mountains. The sediment from the Pinaleno and Santa Teresa Mountains is high in quartz and feldspars, as those mountains are principally of granitic gneiss, schist, and granite. The sediment from the Gila Mountains, which formed principally from lava flows and ash beds, is of basaltic, andesitic, and rhyolitic derivation. The Gila Mountains include a few granitic intrusive rocks along their base.

The sediment was carried into the closed basin by sluggish streams. Most of these streams deposited the sediment along their courses and dried up near the central part of the basin, but some probably fed small intermittent lakes that existed in the central part.

The sediment filling the basin can be divided into three units. The lowest is probably 300 to 500 feet thick in the central part of the basin. Where it crops out in a few places at the base of the mountains, this material is coarse gravel and conglomerate, but south of Thatcher and east of Safford, where it has been observed in deep borings, it is largely a dark-gray clay.

The middle deposit of sediment is as much as 2,000 feet thick. It is fine-grained material and is the major sedimentary fill in the basin. Davidson informally terms this unit "Basin-fill" (*3*).

The uppermost unit of sediment filling the basin consists of thin deposits of gravel.

Depositing of sediment in the basin ended when structural uplift of the area began. This uplift was accompanied by tilting of parts of the basin, and by minor faulting of the beds of basin fill. During this period of uplift, the Gila River formed a course through the central part of the basin, and it began stripping and eroding the basin fill.

As downcutting of the river alternated with periods of stabilization, terraces formed in the basin. Five major terraces were created (fig. 6).

Kinds of soils can be related to the different terrace levels in a general way. Only Continental soils are on terraces T_0 and T_1, and these soils extend down as low as T_3. Cave soils are on terrace levels T_2 through T_4. Pinaleno soils generally are on T_3 and T_4 levels and in some places are on T_2. Ordinarily, the Tres Hermanos, Bitter Spring, and Whitlock soils are on only T_4, but in a few places occur on T_3. Gila, Anthony, Grabe, Pima, and Comoro soils almost exclusively are restricted to the flood plain of the Gila River (Q_{a1}). Anthony and Gila soils also occur on material of the same geologic age as Q_{a1} that is at any of the upper terrace levels.

Where washes cut through the terraces, deposits of gravel are exposed. These gravelly deposits were carried to the Gila River by tributary streams during periods when the level of the river was stabilized. The deposits range from 5 to 40 feet in thickness in most places, but near the central part of the basin some of the deposits of gravel in the ancient channels of the Gila River are as much as 150 feet thick. The deposit of gravelly alluvium along the course of the present Gila River is 3 miles wide and as much as 120 feet thick. This gravelly stream alluvium is under the Gila River, and its bordering flood plain is known as the inner valley.

In the inner valley, ground water is more easily obtained in large amounts than it is elsewhere. Likewise, water is more easily obtained in the shallow alluvium deposited by the major tributaries of the Gila River. Some water also has been obtained from the beds of sand and gravel in the basin fill, but normally the wells are 1,000 feet or more deep. Small amounts of ground water have been obtained from the terrace gravel that lies on top of nearly impermeable, fine-grained basin fill.

The Gila River is the largest and the only perennial stream in the Safford Area, though it is often dry or nearly dry during the month of June. All other drainageways carry water only after rainstorms or from snowmelt in spring. The river enters the eastern part of the survey area, flows southwest to the vicinity of Solomon, then flows northwest through the rest of the Safford Basin. The elevation where the river enters the area is 3,100 feet, and where it leaves, 2,600 feet. The main tributary of the Gila River is San Simon River, which is near the eastern end of the area. Entering the river from the south are Stockton Wash, Graveyard Wash, Frye Creek, Matthews Wash, and Goodwin Wash. Lone Star, Watson, Peck, and Markham are washes that enter from the north.

Climate [6]

The part of this survey that extends from Sanchez to Geronimo and southward from Safford to Artesia has warm, desert climate. The rest of the survey area, which is in the Gila Mountains and extends along the foothills of the Pinaleno Mountains, has warm, semidesert climate. The difference between the two kinds of climate in this part of the State, however, is not great. Areas that have semidesert climate have slightly more precipitation and slightly lower temperatures. Most of the Safford Area has warm, desert climate. The temperature and precipitation data in table 8 are from the weather station at Saf-

[5] EDWARD S. DAVIDSON, geologist, U.S. Geological Survey, assisted in writing this section.

[6] Data for this section were supplied by PAUL C. KANGIESER, State climatologist, U.S. Weather Bureau.

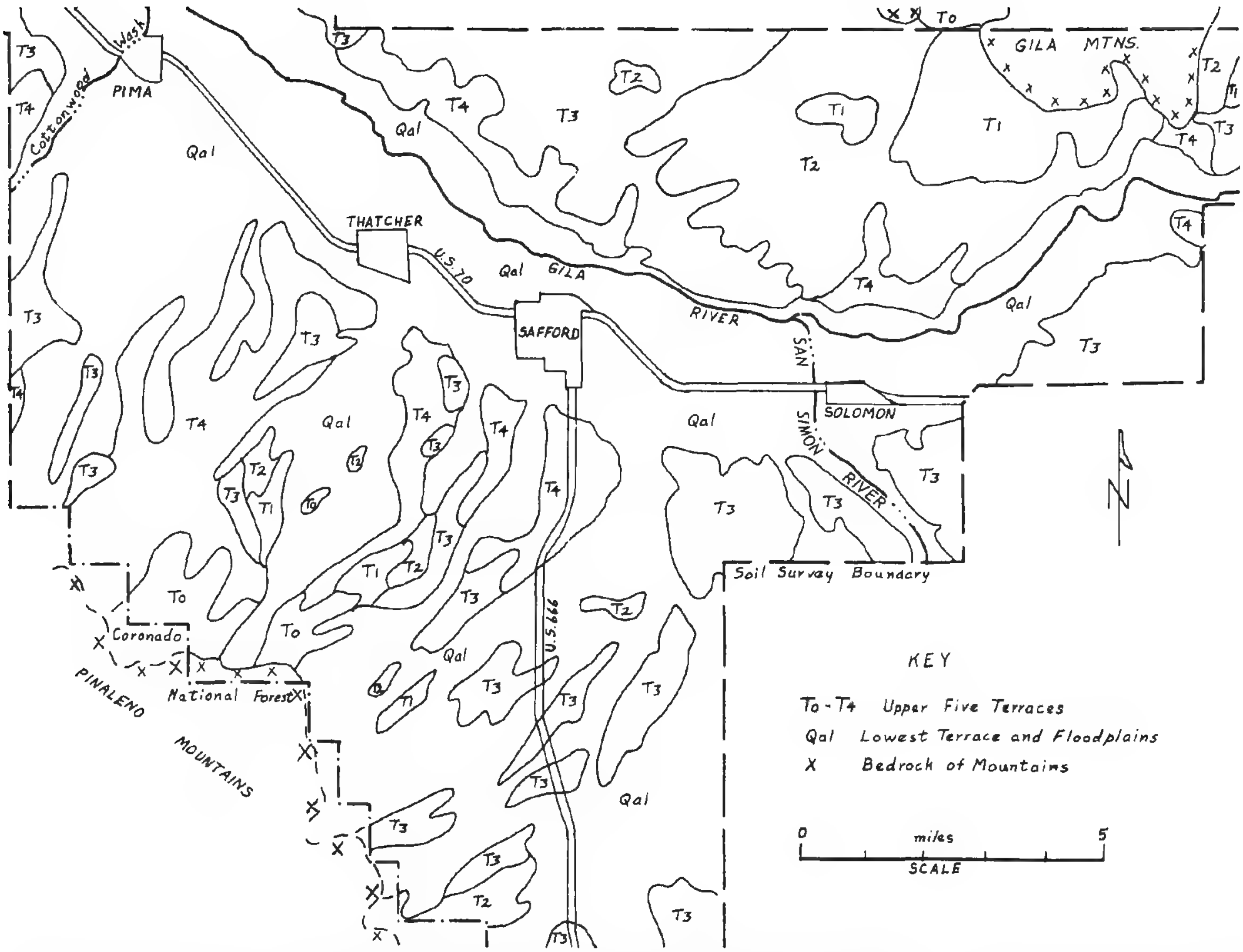

Figure 6.—**Geologic terraces in the Stafford Area. T_0 designates the oldest and highest terraces; T_1 through T_4, progressively more recent and lower terraces; and Q_{al}, the present flood plain of the Gila River.**

ford and are representative of a warm, desert climate (*6*).

Summers are warm, and afternoon temperatures of 100° F. or more occur regularly. Temperature above 110° is not common but occurs on the average of 1 year in every 4. At the higher elevations in the survey area, the temperature is lower than it is on the valley floor. The maximum temperature at these elevations during summer averages about 5 degrees lower, and minimum temperature in winter generally averages 5 to 10 degrees lower.

Precipitation at Safford averages less than 9 inches each year, but more than 2 inches have been recorded in a 24-hour period during heavy summer rainstorms. These storms generally are accompanied by strong winds and hail. During winter, snow is commonly at the summit of the Pinaleno Mountains, but on the average less than 2 inches falls on the valley floor each year. Precipitation at higher elevations is nearly the same as that recorded at Safford, or about 11 or 12 inches annually. Annual snowfall below an elevation of 4,000 feet is usually less than 2 inches.

In general, there are two periods of precipitation annually in the Safford Area. A minor period normally begins in November or December and extends through March, and a major period begins in July and extends through most of September. April, May, and June usually are dry, and October and November are fairly dry, at least until the winter rains begin. On the average, about 20 percent more precipitation occurs during the period from May to October than during the period from November to April. The precipitation in winter comes from the Pacific Ocean, and that in summer, from the Gulf of Mexico. Once or twice during the summer, heavy rains are brought in by winds from a tropical storm on the Pacific Ocean.

Data for humidity are not available for the Safford Area. The amount of moisture in the air generally is

low except during rainy periods. Frequent irrigations together with rainstorms increase the relative humidity in summer. The relative humidity for daytime ranges from about 10 percent during dry periods to about 90 percent during periods of heavy precipitation. The average daily humidity for the year is estimated to be about 25 to 30 percent.

Prevailing winds usually blow from the southeast in summer and from the northwest in winter. These winds are moisture laden and provide moisture for the summer and winter periods of precipitation. Fairly mild, steady winds blow for several successive days in spring. These winds sometimes start in March and continue into April or on into May. They carry little moisture, as shown by the small amount of precipitation recorded for these months in table 8. June has little wind until near the end of the month and generally is warm and dry. Thunderstorms during July and August frequently are accompanied by violent winds, but these storms are of short duration.

The length of the frost-free season can be computed from table 9. This table is for the period from 1933 to 1962 and gives the probabilities that a stated temperature will occur before or after a specified date. For example, 1 year in 10 a temperature of 32° F. would occur as late as April 20, and 5 years in 10 it would occur after March

TABLE 8.—*Summary of temperature and precipitation data at Safford, Ariz.*

[Elevation, 2,900 feet]

Month	Temperature				Precipitation [1]		
	Average daily maximum [2]	Average daily minimum [2]	Two years in 10 will have at least 4 days with—: Maximum temperature equal to or higher than [3]—	Two years in 10 will have at least 4 days with—: Minimum temperature equal to or lower than [3]—	Average monthly total	One year in 10 will have—: Less than—	One year in 10 will have—: More than—
	° F.	° F.	° F.	° F.	Inches	Inches	Inches
January	60	28	70	19	0.7	0.1	1.6
February	66	32	77	22	.5	.1	1.2
March	72	37	83	28	.6	([4])	1.2
April	80	43	92	35	.3	([4])	.7
May	89	50	100	43	.1	([4])	.3
June	98	60	106	52	.3	([4])	.8
July	99	68	107	63	1.8	.6	3.2
August	96	66	103	62	1.4	.4	3.4
September	92	59	101	51	1.1	([4])	2.6
October	82	46	93	37	.6	([4])	1.6
November	70	35	80	26	.5	([4])	1.2
December	61	29	72	21	.7	.1	1.5
Year	80	46	[5] 109	[6] 16	8.6	4.8	12.5

[1] For the period 1933-62.
[2] For the period 1899–1957.
[3] For the period 1933–62.
[4] Trace.
[5] Average annual highest maximum.
[6] Average annual lowest minimum.

TABLE 9.—*Probabilities of last freezing temperatures in spring and first in fall* [1]

Probability	Dates for given probability and temperature				
	16° F. or lower	20° F. or lower	24° F. or lower	28° F. or lower	32° F. or lower
Spring:					
1 year in 10 later than	Feb. 7	Feb. 23	Mar. 11	Apr. 9	Apr. 20
2 years in 10 later than	Jan. 30	Feb. 15	Mar. 2	Mar. 30	Apr. 12
5 years in 10 later than	([2])	Jan. 30	Feb. 13	Mar. 12	Mar. 27
Fall:					
1 year in 10 earlier than	Dec. 18	Nov. 27	Nov. 8	Nov. 2	Oct. 24
2 years in 10 earlier than	Dec. 31	Dec. 7	Nov. 16	Nov. 7	Oct. 29
5 years in 10 earlier than	([2])	Dec. 28	Dec. 3	Nov. 17	Nov. 8

[1] For the period 1933–66.
[2] Computation not feasible.

27. The first freeze in fall occurs before November 8 in about 5 years in 10, or about 50 percent of the time. The average frost-free period is as much as 226 days for 5 years in 10. This length of growing season was obtained by using the dates March 27 and November 8 in the column headed "32° or lower." The number of days actually vary because the dates of the last frost in spring and the first in fall vary, but for 5 years in 10 it will be 226 days. For 1 year in 10, the growing season may be as short as 187 days.

In general, the length of the frost-free, or growing season, is adequate for all corps that are sensitive to frost. Cotton is the main crop that is sensitive to frost, but tomatoes, okra, and other truck crops are sensitive. Most other crops stop growing vigorously after frost but are not killed. Barley, alfalfa, and most pasture live over the winter, but they do not grow new leaves.

Farming

Growing cotton is the main agricultural enterprise in Graham County. It is grown under an acreage allotment plan established by the U.S. Department of Agriculture. Other crops grown in the county are alfalfa, sorghum, barley, corn, and some truck crops. Many kinds of grasses are grown in irrigated pastures, and there are orchards of apricots, peaches, apples, and pecans.

Cotton is the main cash crop grown in the county. Upland cotton acreage reached a peak of 17,000 acres in 1951, and American-Egyptian cotton acreage reached 17,000 acres in 1963. Upland cotton is short-staple cotton and makes up about one-third of the total acreage grown in the county. The American-Egyptian, or long-staple, cotton makes up about two-thirds. According to the census of agriculture, about 23,600 acres of cotton was grown in Graham County in 1964. The cotton is planted on preirrigated soils about the middle of April. About 36 to 40 inches of water is needed to grow a crop of cotton. Many varieties of cotton are grown in the county. The main varieties of short-staple cotton are Acala 1517C and Acala 1517D. These varieties were developed in New Mexico. The principal varieties of long-staple cotton are the Pima S-1 and Pima S-2, which were developed in Arizona.

Other crops are grown in rotation with cotton to help produce better quality and yields of cotton. The acreage of alfalfa for hay, barley for grain, and sorghum has remained about the same for the last several years, but the acreage of sorghum in 1965 was more than double the acreage in 1964. According to the census of agriculture, the acreage of principal crops grown in Graham County in 1964, rounded to the nearest 50 acres, is listed as follows:

Crop:	*Acres*
Corn	150
Sorghum	8,450
Barley	4,250
Alfalfa	4,600
Cotton	23,600

Irrigated crops were grown on 46,550 acres in the county. The foregoing acreages are for Graham County, but most of the farming in the county is in the Safford Area.

Alfalfa, the second crop in importance, is grown for feeding both dairy and beef cattle and as a soil-improving crop in rotations. About 50 inches of water is needed for best growth, and the alfalfa commonly is cut five times each year.

A few ranchers produce beef cattle. The cattle live partly on irrigated pasture (fig. 7) and partly on range before they are put into the feedlot. Irrigated pasture generally consists of alta or Goars fescue, tall wheatgrass, or Coastal bermudagrass. Alta and Goars fescue and tall wheatgrass are cool-season plants and are suited to clayey soils. The bermudagrass is used mainly on sandier soils for summer pasture. Tall wheatgrass and Coastal bermudagrass are suited to saline and alkali soils and are drought resistant. Some irrigated pasture plants are cut for hay; others are cut, chopped, and fed green in feedlots.

Small grains, mainly barley, are used for grain and as green manure. These crops generally follow cotton. If they are used as green manure, they are fertilized liberally with nitrogen and phosphate to produce a heavy growth and are turned under prior to planting cotton the next spring. Sorghum is grown primarily for silage. It is generally planted in May, reaches the proper stage of maturity in about 100 days, and is harvested and stored in pit silos. Apricots, peaches, melons, apples, and garden vegetables are grown on a small acreage and are sold locally.

Unirrigated areas are used as desert range for producing beef cattle, mainly on the cow and calf plan. The main forage vegetation on this range is annual grasses on the low terraces, weeds on the flats, and mesquite in drainageways. Annual grasses and weeds grow for only short periods after rains in spring or summer, and mesquite produces leaves and beans that are grazed in spring or early in summer. Soils that are at higher elevations or that receive more rainfall produce more kinds of perennial vegetation suitable for grazing. These plants grow well after rainy periods, and in some areas can be grazed throughout the year. If these plants are allowed to produce seed in alternate years, they remain vigorous and in good stand. Permits are granted to some ranchers for grazing cattle on lands in the Coronado National Forest.

Industry

Farming is the dominant enterprise of the survey area, and most industries are related to farming. Several cotton gins are located at Safford, Pima, and Cork, and an oil-extracting plant is at Safford. A creamery at Safford collects and distributes milk and makes butter and ice cream. Also at Safford are a meat packing and distributing plant, a garment factory, and a plant that makes concrete building blocks.

Transportation and Community Facilities

The Safford Area has adequate transportation facilities. U.S. Highway No. 70 crosses the area in a northwest-southeast direction, and U.S. Highway No. 666 runs south from Safford. State Route 366 runs southwest from U.S. Highway No. 666 south of Safford to the Coronado National Forest and to recreation areas in the Pinaleno Mountains. The main county roads

Figure 7.—**Beef cattle of mixed breeds grazing on irrigated Goars fescue near Solomon. The soil is Guest clay.**

through the area are paved, and roads in outlying areas are graded and drained. A branch line of the Southern Pacific Railroad runs through the area.

The survey area has adequate public schools and a junior college, and there is a public library at Safford. Churches of most denominations are in Safford or other parts of the area.

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Glossary

Aggregate, soil. Many fine particles held in a single mass or cluster, such as a clod, crumb, block, or prism.

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is reduced.

Available moisture holding capacity. The capacity of a soil to hold water in a form available to plants. As used in this survey, the available moisture holding capacity is based on the amount of moisture, in inches, that is held within the depth generally penetrated by roots. Terms used to describe available moisture holding capacity are—*good* (7½ inches), *fair* (5 to 7½ inches), *poor* (3¾ to 5 inches), and *very poor* (3¾ inches).

Caliche. A more or less cemented deposit of calcium carbonate in many soils of warm-temperature areas, as in the Southwestern States. The material may consist of soft, thin layers in the soil or of hard, thick beds just beneath the solum, or it may be exposed at the surface by erosion.

Control section. The part of a soil profile that strongly influences the placement of a soil in the current system of soil classification. As used in the survey area, it extends from a depth of 10 inches to 40 inches, or to the bottom of the diagnostic horizon if that horizon extends below 40 inches but not below 60 inches.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Desert range. Rangeland on the desert that provides limited grazing, mainly of desert plants and annual grasses and weeds. This land generally is not suited to irrigation, or water for irrigation is not available.

Desert varnish. A glossy covering or coating of dark-colored compounds, probably composed of iron and manganese, on exposed pebbles, stones, and large rock surfaces in hot deserts.

Erosion pavement. A residue of pebbles and stones on a land surface formed by the removal of the finer surface particles by wind or water.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon. The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon. The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon. The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused by (1) accumulation of clay, sesquioxides, humus, or some combination of these; (2) prismatic or blocky structure; (3) redder or stronger colors than the A horizon; or (4) some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon. The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer. Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Inner valley. Flood plain and low terraces adjacent to the Gila River and its tributaries; sometimes called the valley floor. Formed by processes of degradation and deposition.

Permeability. The quality of a soil horizon that enables water or air to move through it. Terms used to describe permeability are as follows: *Very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour" soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Mildly alkaline	7.4 to 7.8
Very strongly acid	4.5 to 5.0	Moderately alkaline	7.9 to 8.4
Strongly acid	5.1 to 5.5	Strongly alkaline	8.5 to 9.0
Medium acid	5.6 to 6.0	Very strongly alkaline	9.1 and higher
Slightly acid	6.1 to 6.5		
Neutral	6.6 to 7.3		

Saline soil. A soil that contains soluble salts in amounts that impair growth of plants but that does not contain excess exchangeable sodium.

Salinity, soil. Salinity of soils is based on the electrical conductivity of saturated soil extract and is expressed in millimhos per centimeter (mmhos/cm) at 25° C. The readings are: Less than 2 (none), 2–4 (slight), 4–8 (moderate), 8–16 (severe), and more than 16 (very severe).

Sand. Individual rock or mineral fragments in soils having diameters ranging from 0.05 millimeter to 2.0 millimeters. Most sand grains consist of quartz, but they may be any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting upon parent material, as conditioned by relief over periods of time.

Solum. The upper part of a soil profile, above the parent material in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. In many soils, technically, the B horizon; roughly, the part of the profile below plow depth.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plow layer.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surplus runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Tillage pan. A compacted layer formed in the soil immediately below the plowed layer.

Topsoil. Presumed fertile soil or soil material, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Wash. A term used in the arid western part of the United States to describe the dry bed of an intermittent stream that in places is at the bottom of a canyon. Also called a Dry Wash. In this survey the term refers to intermittent streams.

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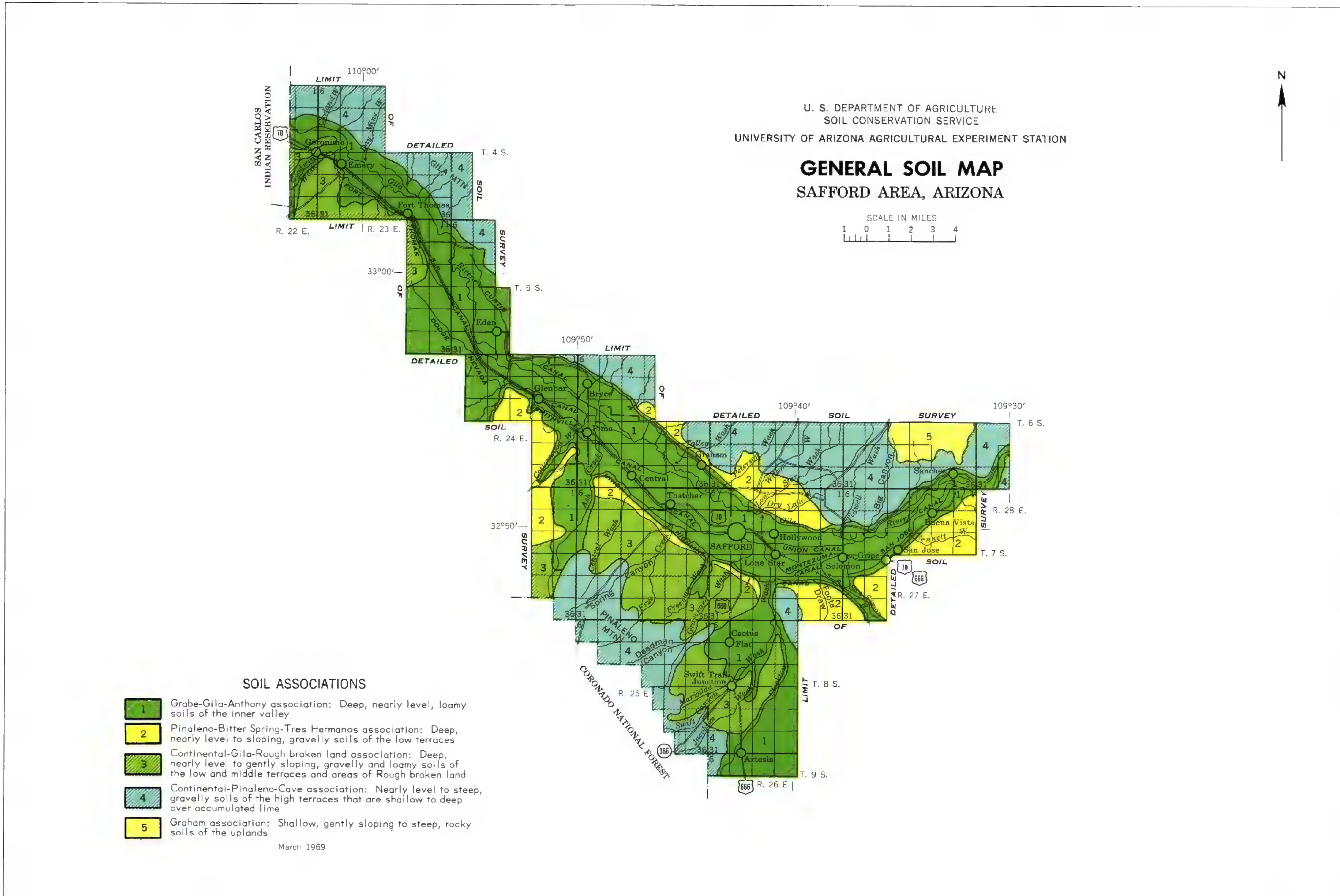
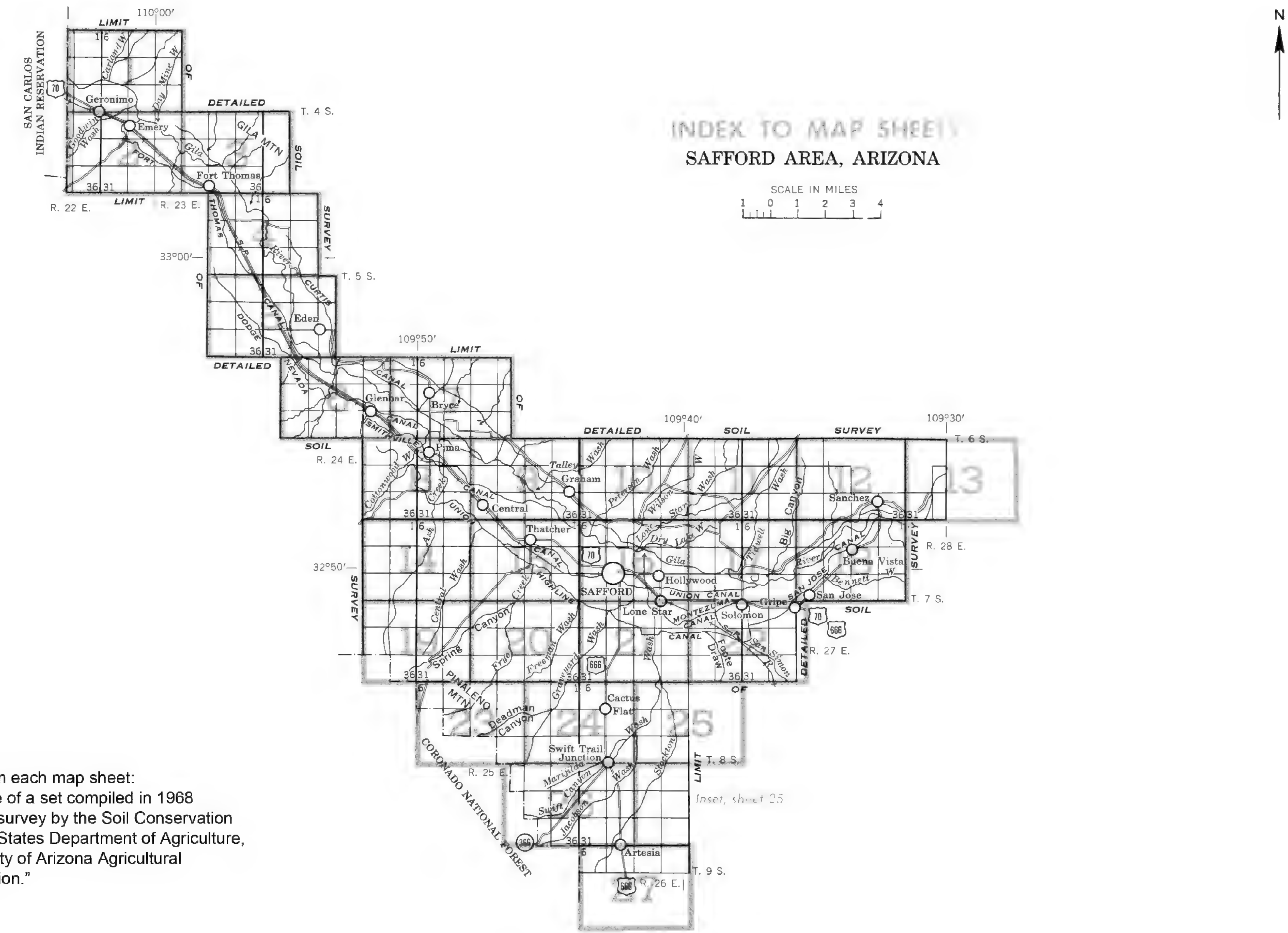

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
UNIVERSITY OF ARIZONA AGRICULTURAL EXPERIMENT STATION
GENERAL SOIL MAP
SAFFORD AREA, ARIZONA
SCALE IN MILES
1 0 1 2 3 4
N
SAN CARLOS INDIAN RESERVATION
CORONADO NATIONAL FOREST
LIMIT OF DETAILED SOIL SURVEY
110°00′
109°50′
109°40′
109°30′
33°00′
32°50′
T. 4 S.
T. 5 S.
T. 6 S.
T. 7 S.
T. 8 S.
T. 9 S.
R. 22 E.
R. 23 E.
R. 24 E.
R. 25 E.
R. 26 E.
R. 27 E.
R. 28 E.
Geronimo
Emery
Fort Thomas
Eden
Glenbar
Bryce
Pima
Central
Thatcher
Graham
SAFFORD
Hollywood
Lone Star
Solomon
Gripe
San Jose
Buena Vista
Sanchez
Cactus Flat
Swift Trail Junction
Artesia
Gila River
PINALENO MTN
GILA MTN
SOIL ASSOCIATIONS
1 Grabe-Gila-Anthony association: Deep, nearly level, loamy soils of the inner valley
2 Pinaleno-Bitter Spring-Tres Hermanos association: Deep, nearly level to sloping, gravelly soils of the low terraces
3 Continental-Gila-Rough broken land association: Deep, nearly level to gently sloping, gravelly and loamy soils of the low and middle terraces and areas of Rough broken land
4 Continental-Pinaleno-Cave association: Nearly level to steep, gravelly soils of the high terraces that are shallow to deep over accumulated lime
5 Graham association: Shallow, gently sloping to steep, rocky soils of the uplands
March 1969



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"This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the University of Arizona Agricultural Experiment Station."

SOIL LEGEND

The first capital letter is the initial one of the soil name. A second capital letter, A, B, C, D, E, or F, shows a class of slope. Most symbols without a slope letter are those of nearly level soils or land types but some are for soils or land types that have a considerable range in slope.

SYMBOL	NAME
Ac	Agua clay loam
Ag	Agua loam
AhA	Anthony clay loam, 0 to 2 percent slopes
AlB	Anthony gravelly sandy loam, 0 to 5 percent slopes
AmA	Anthony loam, 0 to 2 percent slopes
AnA	Anthony sandy loam, 0 to 2 percent slopes
ApB	Anthony–Continental–Pinaleno gravelly sandy loams, 0 to 5 percent slopes
ArA	Anthony and Gila gravelly sandy loams, 0 to 2 percent slopes
AuA	Arizo sandy loam, 0 to 2 percent slopes
AvA	Arizo gravelly sandy loam, 0 to 2 percent slopes
AvB	Arizo gravelly sandy loam, 2 to 5 percent slopes
AwA	Arizo loam, 0 to 2 percent slopes
AzA	Arizo gravelly loam, 0 to 2 percent slopes
BeB	Bitter Spring gravelly sandy loam, 2 to 5 percent slopes
BpB	Bitter Spring–Pinaleno complex, 0 to 5 percent slopes
Br	Brazito loam
Bt	Brazito sandy loam
ChB	Cave gravelly sandy loam, 0 to 5 percent slopes
ChE	Cave gravelly sandy loam, 5 to 30 percent slopes
CkD	Cave–Pinaleno complex, 0 to 20 percent slopes
ClF	Cellar soils, 2 to 50 percent slopes
Cm	Comoro loam
Cn	Comoro loam, mottled variant
Co	Comoro sandy loam
CrB	Continental cobbly sandy loam, 2 to 5 percent slopes
CsB	Continental–Gila gravelly sandy loams, 0 to 5 percent slopes
CtB	Continental–Pinaleno complex, 0 to 5 percent slopes
GbA	Gila gravelly loam, 0 to 2 percent slopes
GcA	Gila loam, 0 to 2 percent slopes
GcB	Gila loam, 2 to 5 percent slopes
GeA	Gila loam, saline, 0 to 2 percent slopes
GfA	Gila sandy loam, 0 to 2 percent slopes
GgA	Gila and Glendale soils, 0 to 2 percent slopes
Gm	Glendale loam
Gn	Glendale silt loam, saline
Go	Glendale silt loam, saline–alkali
Gp	Glendale silty clay loam, saline
Gr	Grabe clay loam
Gs	Grabe loam
Gt	Grabe loam, saline
GuE	Graham extremely rocky clay loam, 2 to 40 percent slopes
Gv	Gravelly alluvial land
Gy	Guest clay
Ma	Maricopa loam
Mr	Maricopa sandy loam
Pa	Pima clay
Pc	Pima clay loam
Pe	Pima clay loam, saline
Pm	Pima loam
PnB	Pinaleno cobbly loam, 2 to 5 percent slopes
PrB	Pinaleno gravelly loam, 0 to 5 percent slopes
PsB	Pinaleno–Bitter Spring complex, 0 to 5 percent slopes
PuB	Pinaleno–Cave complex, 0 to 5 percent slopes
PvC	Pinaleno–Continental gravelly sandy loams, 0 to 10 percent slopes
Rh	Riverwash
Rk	Rock land
Ro	Rough broken land
TdB	Tidwell extremely rocky sandy loam, 0 to 5 percent slopes
TeA	Tidwell sandy loam, 0 to 2 percent slopes
TgA	Tidwell, Gila and Glendale soils, saline, 0 to 2 percent slopes
ThC	Tres Hermanos–Bitter Spring gravelly sandy loams, 0 to 10 percent slopes
WhA	Whitlock loam, 0 to 2 percent slopes
WkA	Whitlock sandy loam, 0 to 2 percent slopes
WkB	Whitlock sandy loam, 2 to 5 percent slopes

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Dual
- Good motor
- Poor motor

Highway markers
- National Interstate
- U. S.
- State or county

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail
- Railroad
- Ferry — FY
- Ford — FORD
- Grade
- R. R. over
- R. R. under

Tunnel

Buildings
- School
- Church

Mine and quarry

Gravel pit

Power line

Pipeline

Cemetery

Dams

Levee

Tanks

Cotton gin

Windmill

BOUNDARIES

- National or state
- County
- Project area
- Reservation
- Land grant
- Small park, cemetery, airport
- Land survey division corners

DRAINAGE

Streams, double-line
- Perennial
- Intermittent

Streams, single-line
- Perennial
- Intermittent
  - Crossable with tillage implements
  - Not crossable with tillage implements
  - Unclassified

Canals and ditches — CANAL

Aqueduct

Lakes and ponds
- Perennial — water, w
- Intermittent

Spring

Marsh or swamp

Wet spot

Alluvial fan

Drainage end

Well, irrigation

Well, artesian

RELIEF

Escarpments
- Bedrock
- Other

Short steep slope

SOIL SURVEY DATA

- Soil boundary and symbol — Dx
- Gravel
- Stoniness
  - Stony
  - Very stony
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gully

Soil map constructed 1968 by Cartographic Division, Soil Conservation Service, USDA, from 1952 aerial photographs. Controlled mosaic based on Arizona plane coordinate system, east zone, transverse Mercator projection, 1927 North American datum.

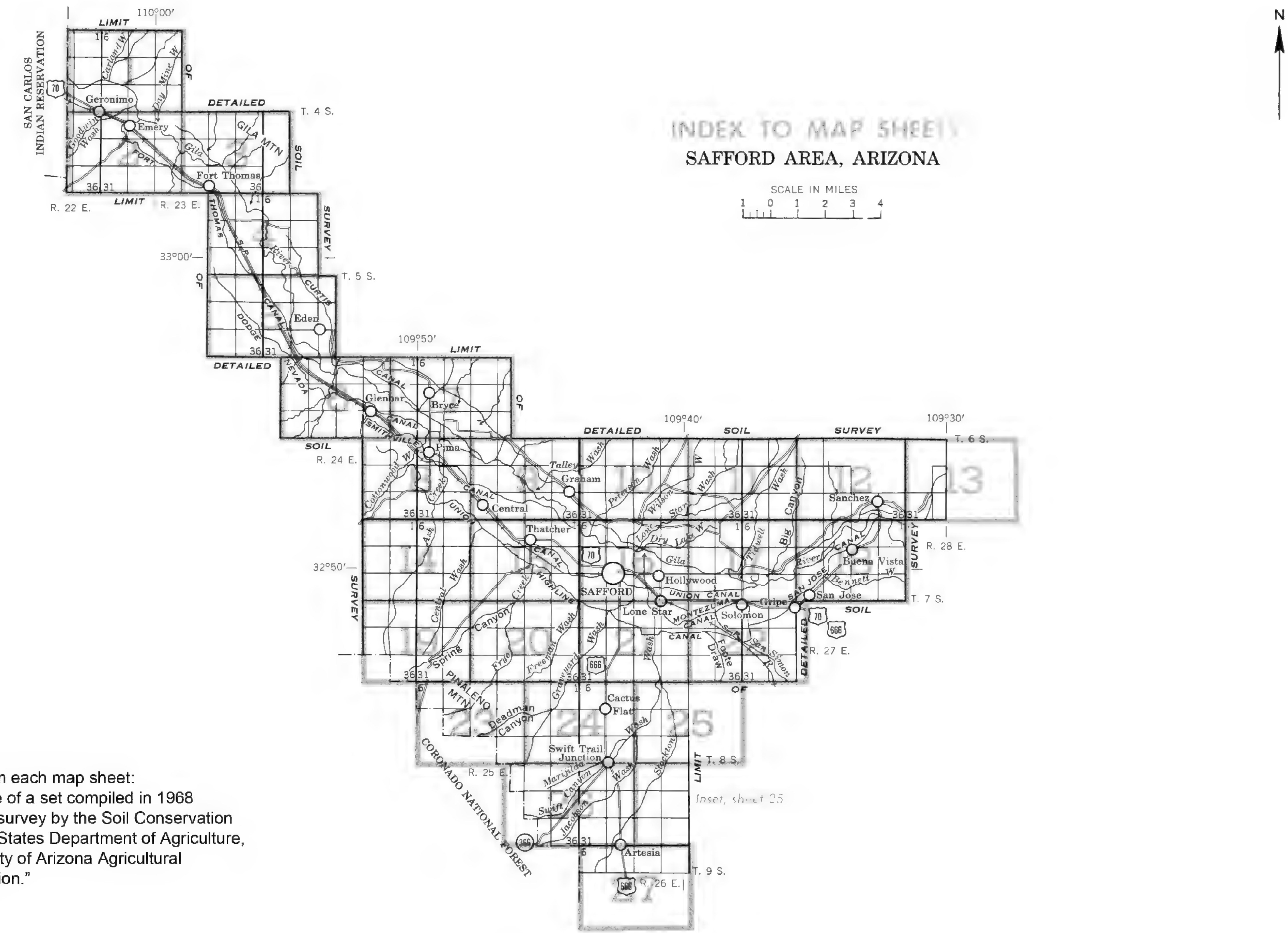
GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. Other information is given in tables as follows:

Acreage and extent, table 1, p. 7.
Estimated yields, table 2, p. 34.

Engineering uses of soils, tables 3, 4, and 5, pp. 36 through 47.

Map symbol	Mapping unit	Described on page	Irrigated capability unit		Dryland capability unit	
			Symbol	Page	Symbol	Page
Ac	Agua clay loam	7	IIs-5	28	------	--
Ag	Agua loam	6	IIs-5	28	VIIs-1	31
AhA	Anthony clay loam, 0 to 2 percent slopes	8	IIs-3	28	------	--
AlB	Anthony gravelly sandy loam, 0 to 5 percent slopes	8	------	--	VIIs-1	31
AmA	Anthony loam, 0 to 2 percent slopes	8	IIs-3	28	VIIs-1	31
AnA	Anthony sandy loam, 0 to 2 percent slopes	8	IIs-6	29	VIIs-1	31
ApB	Anthony-Continental-Pinaleno gravelly sandy loams, 0 to 5 percent slopes	8	------	--	VIIs-1	31
AtA	Anthony and Gila gravelly sandy loams, 0 to 2 percent slopes	9	------	--	VIIs-1	31
AuA	Arizo sandy loam, 0 to 2 percent slopes	9	IVs-1	30	VIIs-3	31
AvA	Arizo gravelly sandy loam, 0 to 2 percent slopes	9	IVs-1	30	VIIs-3	31
AvB	Arizo gravelly sandy loam, 2 to 5 percent slopes	9	------	--	VIIs-3	31
AwA	Arizo loam, 0 to 2 percent slopes	9	IIIs-2	30	VIIs-3	31
AzA	Arizo gravelly loam, 0 to 2 percent slopes	9	IVs-1	30	VIIs-3	31
BeB	Bitter Spring gravelly sandy loam, 2 to 5 percent slopes	10	------	--	VIIs-7	32
BpB	Bitter Spring-Pinaleno complex, 0 to 5 percent slopes	10	------	--	VIIs-7	32
Br	Brazito loam	11	IIIs-2	30	VIIs-3	31
Bt	Brazito sandy loam	10	IVs-1	30	VIIs-3	31
ChB	Cave gravelly sandy loam, 0 to 5 percent slopes	11	------	--	VIIs-7	32
ChE	Cave gravelly sandy loam, 5 to 30 percent slopes	11	------	--	VIIe-1	30
CkD	Cave-Pinaleno complex, 0 to 20 percent slopes	12	------	--	VIIs-7	32
ClF	Cellar soils, 2 to 50 percent slopes	12	------	--	VIIs-6	32
Cm	Comoro loam	13	IIs-3	28	VIIs-1	31
Cn	Comoro loam, mottled variant	13	IIs-3	28	VIIs-1	31
Co	Comoro sandy loam	12	IIs-6	29	VIIs-1	31
CrB	Continental cobbly sandy loam, 2 to 5 percent slopes	14	------	--	VIIs-4	31
CsB	Continental-Gila gravelly sandy loams, 0 to 5 percent slopes	13	------	--	VIIs-7	32
CtB	Continental-Pinaleno complex, 0 to 5 percent slopes	14	------	--	VIIs-4	31
GbA	Gila gravelly loam, 0 to 2 percent slopes	15	I-3	27	VIIc-1	33
GcA	Gila loam, 0 to 2 percent slopes	14	I-1	26	VIIc-1	33
GcB	Gila loam, 2 to 5 percent slopes	15	------	--	VIIc-1	33
GeA	Gila loam, saline, 0 to 2 percent slopes	15	IIs-1	27	VIIs-2	31
GfA	Gila sandy loam, 0 to 2 percent slopes	15	I-3	27	VIIc-1	33
GgA	Gila and Glendale soils, 0 to 2 percent slopes	15	------	--	VIIc-1	33
Gm	Glendale loam	16	I-1	26	VIIc-1	33
Gn	Glendale silt loam, saline	16	IIs-2	28	VIIs-2	31
Go	Glendale silt loam, saline-alkali	16	IIs-2	28	VIIs-2	31
Gp	Glendale silty clay loam, saline	16	IIs-2	28	VIIs-2	31
Gr	Grabe clay loam	16	I-2	27	------	--
Gs	Grabe loam	17	I-1	26	VIIc-1	33
Gt	Grabe loam, saline	17	IIs-1	27	VIIs-2	31
GuE	Graham extremely rocky clay loam, 2 to 40 percent slopes	17	------	--	VIIs-5	32
Gv	Gravelly alluvial land	18	------	--	VIIs-3	31
Gy	Guest clay	18	IIs-4	28	------	--
Ma	Maricopa loam	19	IIs-5	28	VIIs-1	31
Mr	Maricopa sandy loam	19	IIIs-2	30	VIIs-1	31
Pa	Pima clay	20	IIs-4	28	------	--
Pc	Pima clay loam	19	I-2	27	------	--
Pe	Pima clay loam, saline	20	IIs-2	28	------	--
Pm	Pima loam	20	IIs-7	29	VIIs-1	31
PnB	Pinaleno cobbly loam, 2 to 5 percent slopes	21	------	--	VIIs-4	31
PrB	Pinaleno gravelly loam, 0 to 5 percent slopes	20	------	--	VIIs-4	31
PsB	Pinaleno-Bitter Spring complex, 0 to 5 percent slopes	21	------	--	VIIs-4	31
PuB	Pinaleno-Cave complex, 0 to 5 percent slopes	21	------	--	VIIs-4	31
PvC	Pinaleno-Continental gravelly sandy loams, 0 to 10 percent slopes	21	------	--	VIIs-4	31
Rh	Riverwash	21	------	--	VIIIw-1	33
Rk	Rock land	21	------	--	VIIs-8	32
Ro	Rough broken land	21	------	--	VIIIs-1	33
TdB	Tidwell extremely rocky sandy loam, 0 to 5 percent slopes	22	------	--	VIIs-8	32
TeA	Tidwell sandy loam, 0 to 2 percent slopes	22	IVs-2	30	VIIs-8	32
TgA	Tidwell, Gila and Glendale soils, saline, 0 to 2 percent slopes	22	------	--	VIIs-8	32
ThC	Tres Hermanos-Bitter Spring gravelly sandy loams, 0 to 10 percent slopes	23	------	--	VIIs-7	32
WhA	Whitlock loam, 0 to 2 percent slopes	24	IIIs-1	29	VIIs-7	32
WkA	Whitlock sandy loam, 0 to 2 percent slopes	23	IIIs-1	29	VIIs-7	32
WkB	Whitlock sandy loam, 2 to 5 percent slopes	24	------	--	VIIe-1	30



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and the University of Arizona Agricultural
Experiment Station."

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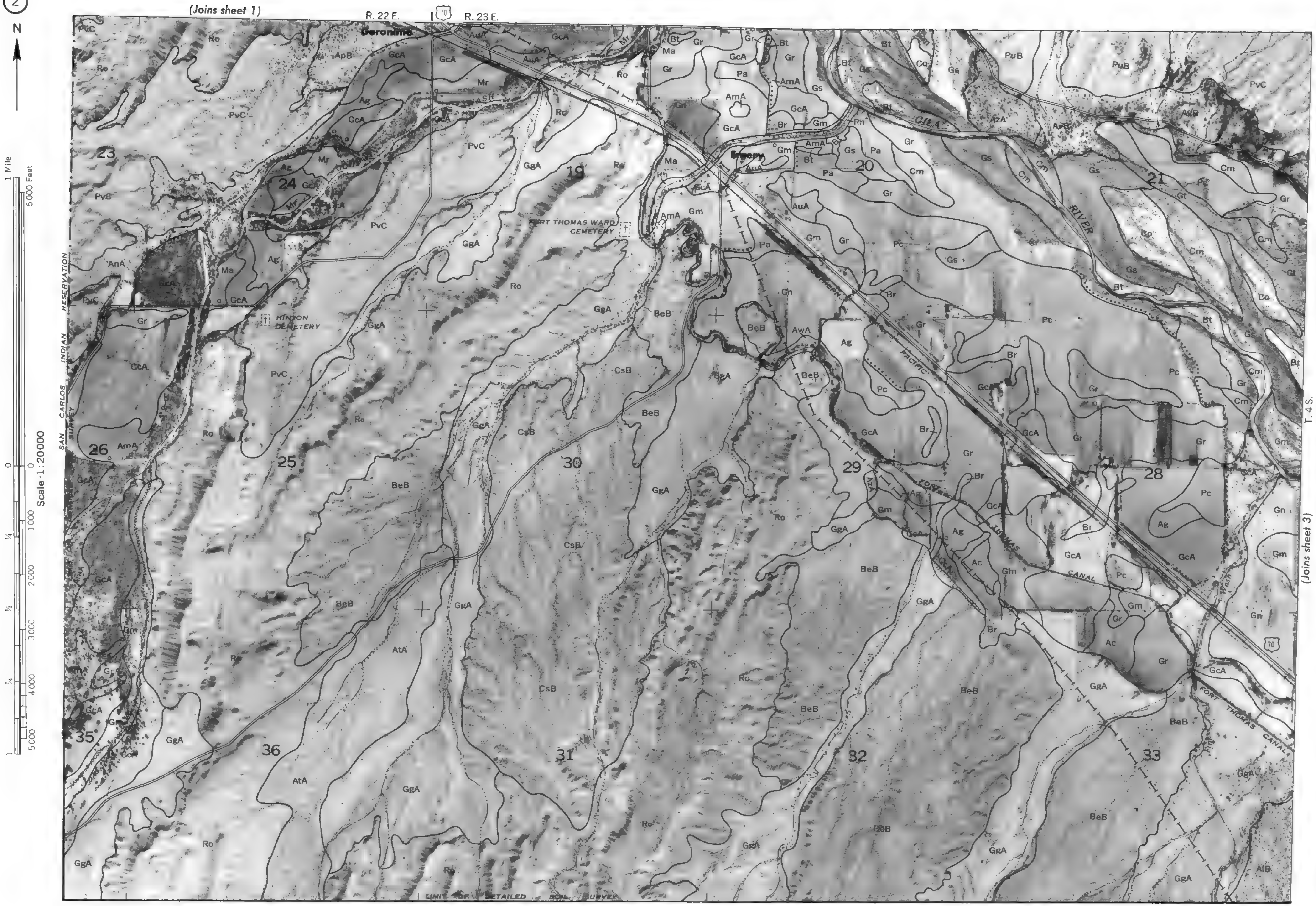

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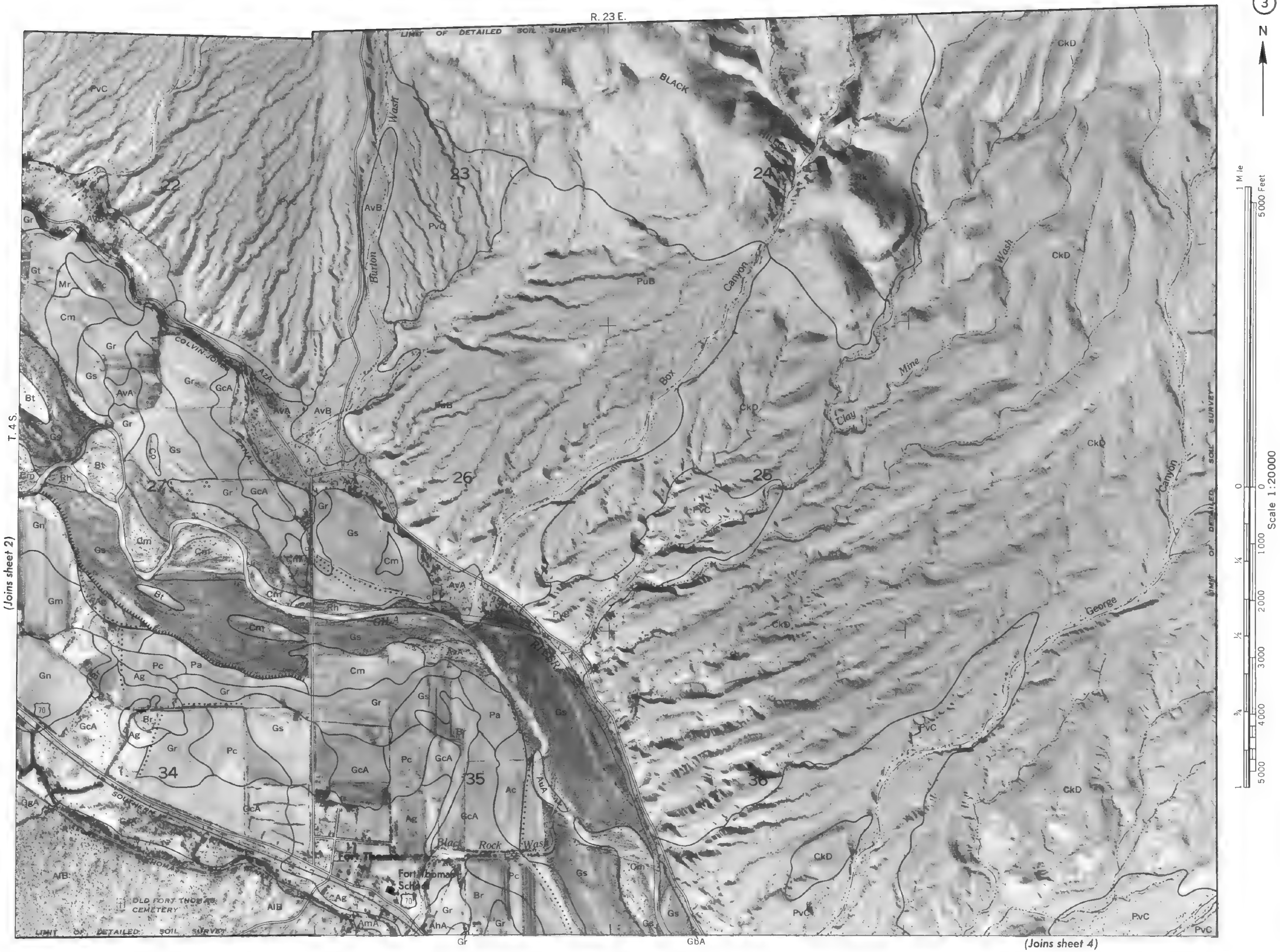

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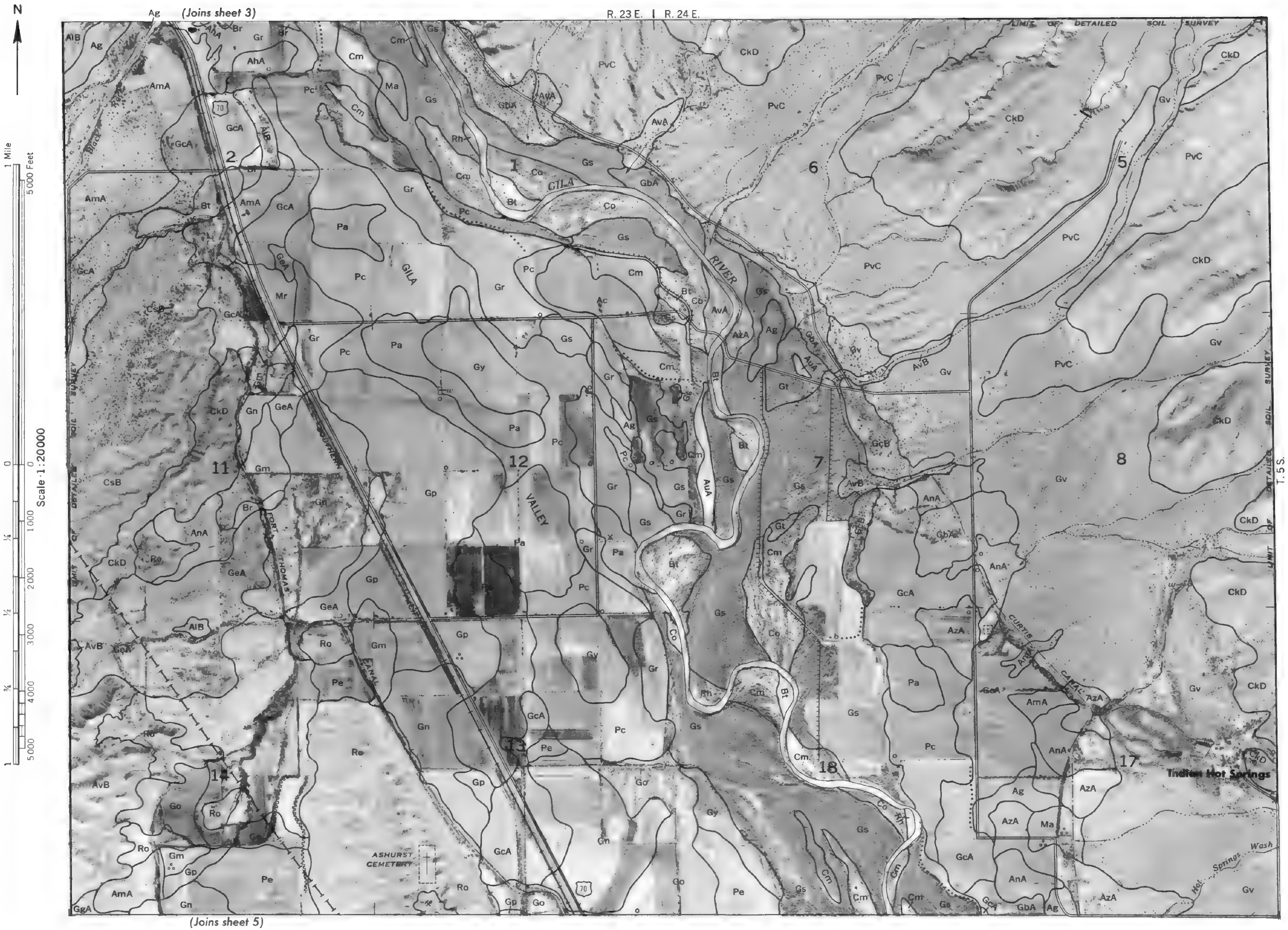

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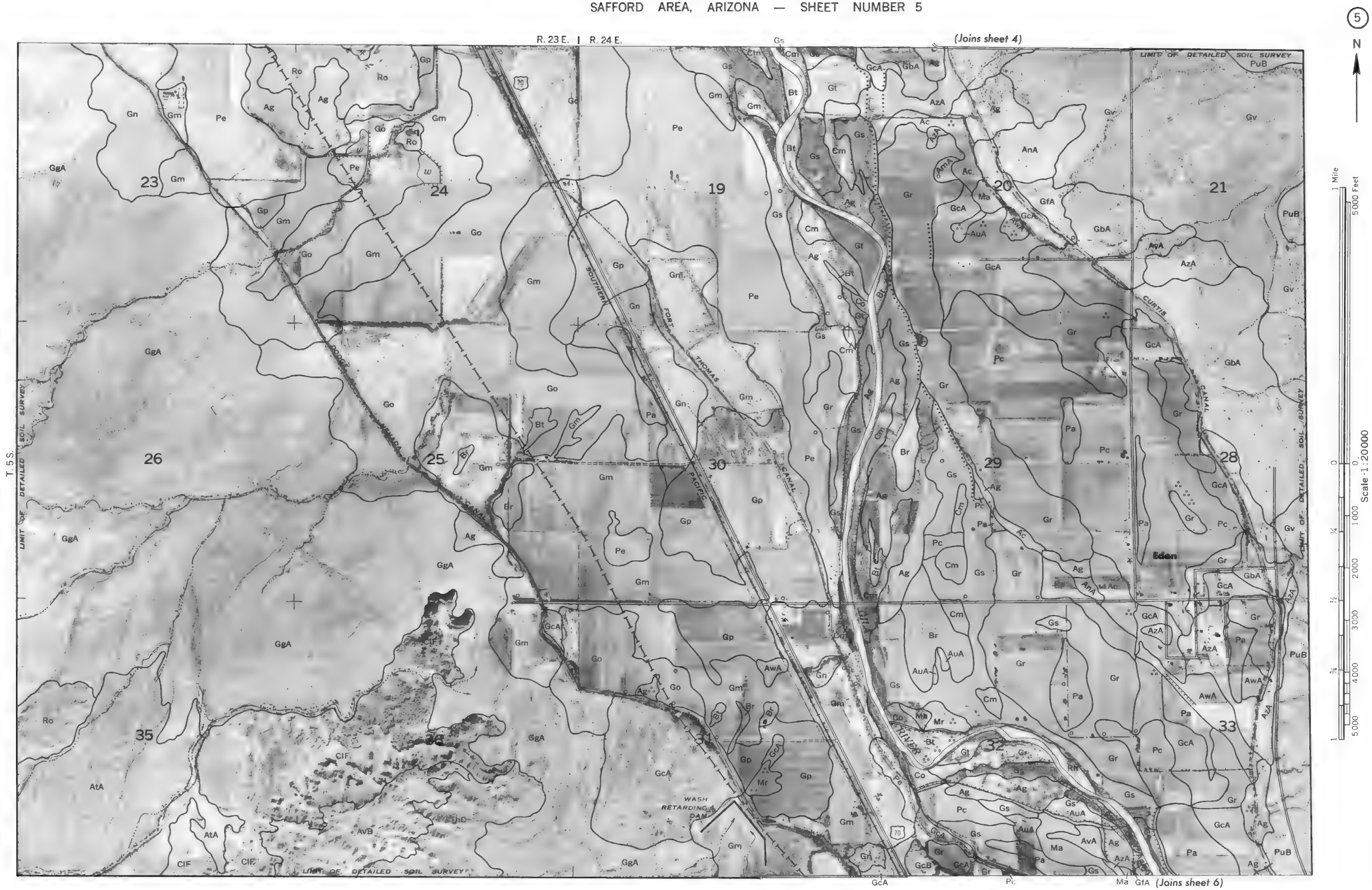


Land division corners are approximately positioned on this map.

SAFFORD AREA, ARIZONA — SHEET NUMBER 6

Land division corners are approximately positioned on this map

7

N

R. 24 E. | R. 25 E.

T. 6 S.

(Joins sheet 6)

(Joins sheet 8) | (Joins sheet 9)

Scale 1:20000

1 Mile

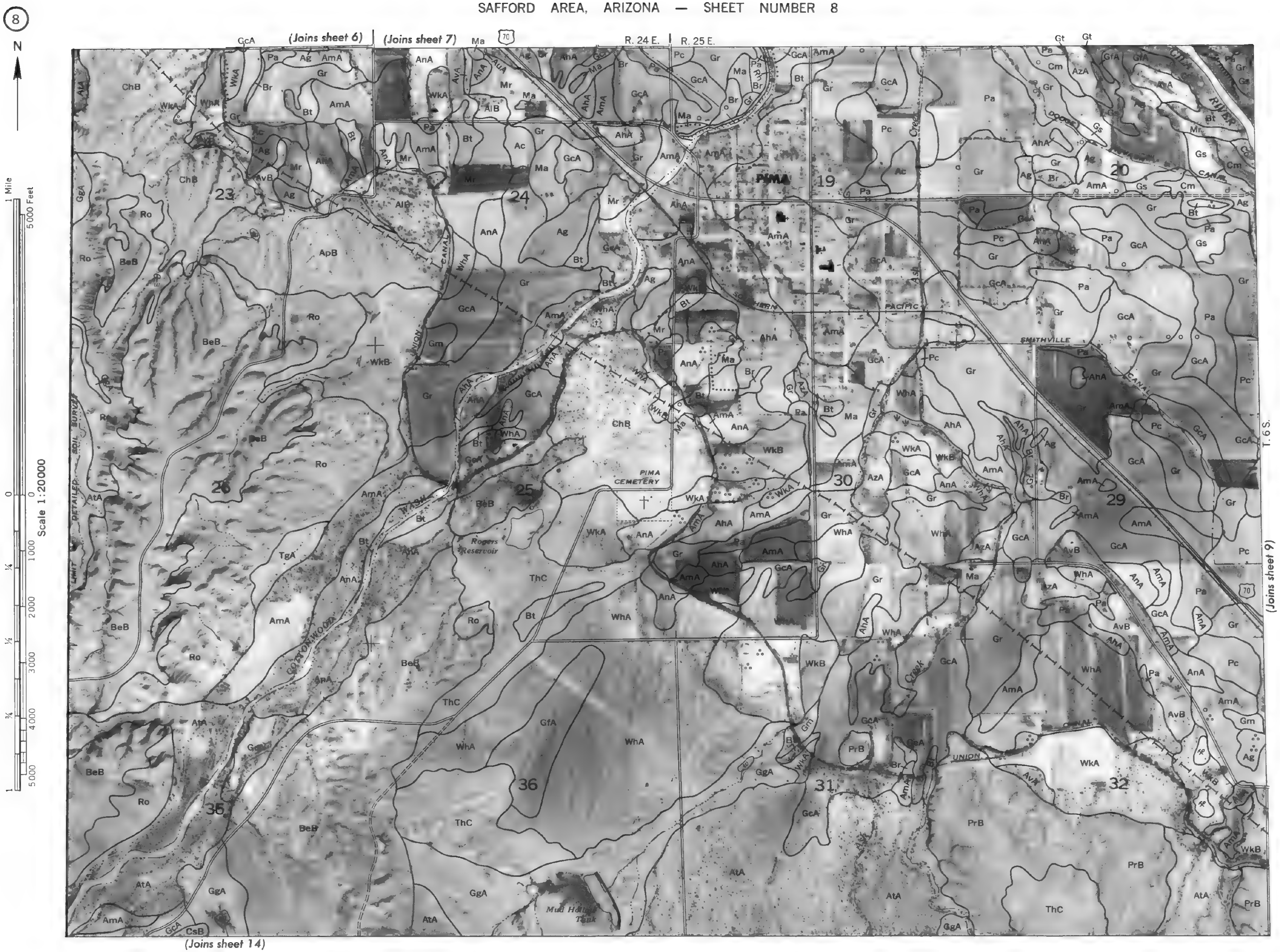
5000 Feet

0 ¼ ½ ¾ 1

0 1000 2000 3000 4000 5000

Land division corners are approximately positioned on this map.

SAFFORD AREA, ARIZONA — SHEET NUMBER 8



Land division corners are approximately positioned on this map.

Land division corners are approximately positioned on this map.

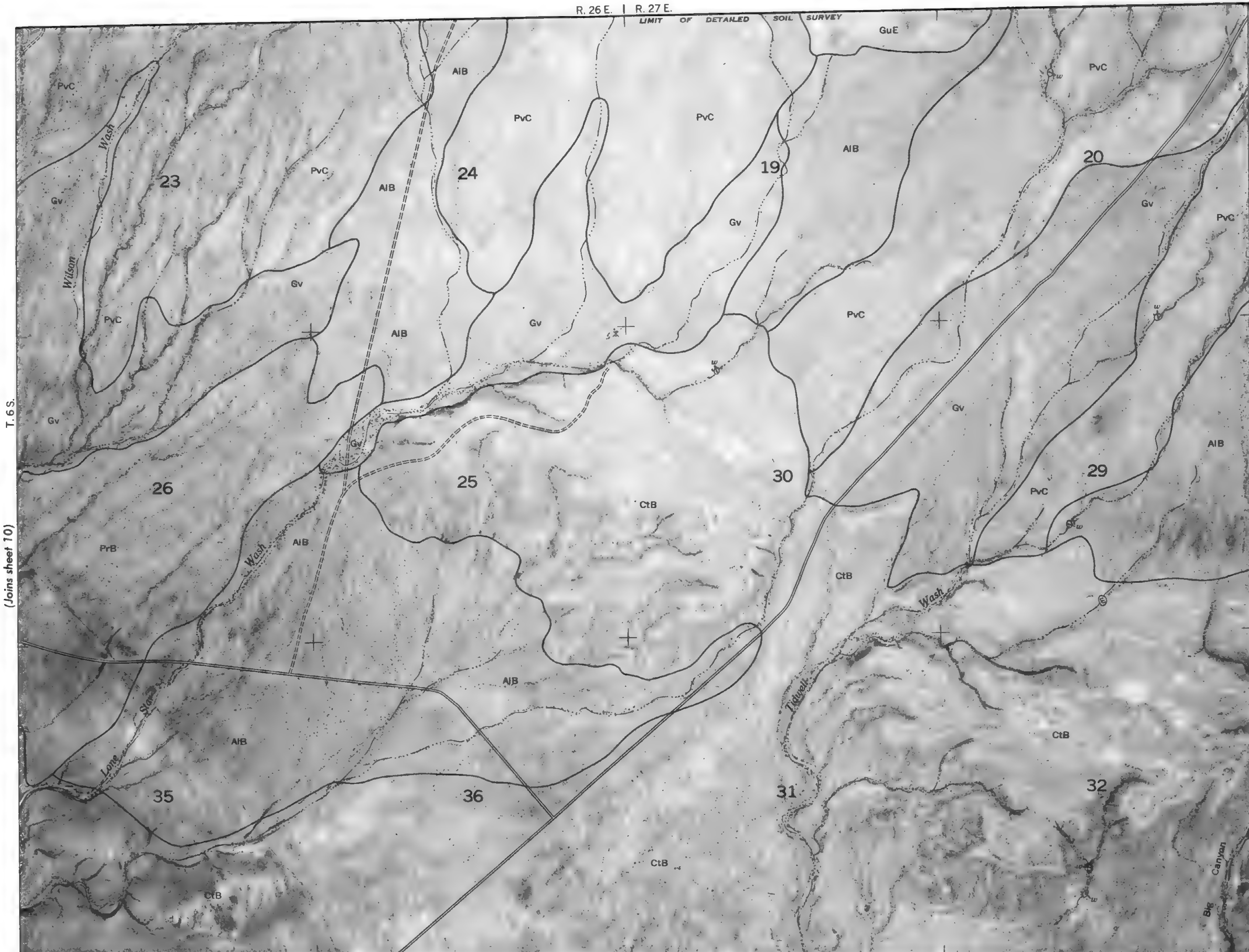
Land division corners are approximately positioned on this map

11

N

Land division corners are approximately positioned on this map.

(Joins sheet 10)



(Joins sheet 12)

(Joins sheet 17)

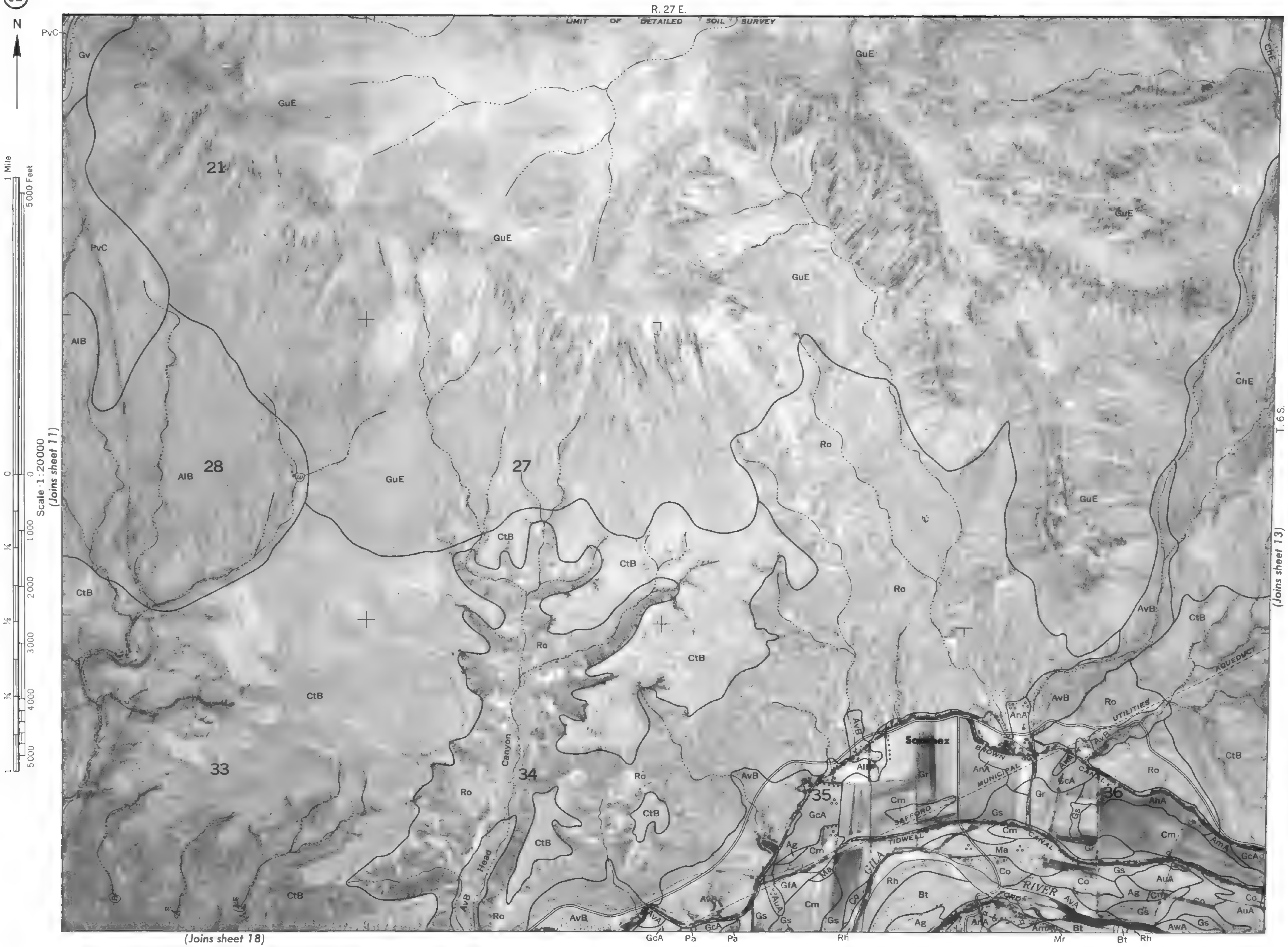
Scale 1:20000

1 Mile

5000 Feet

0 ¼ ½ ¾ 1

0 1000 2000 3000 4000 5000



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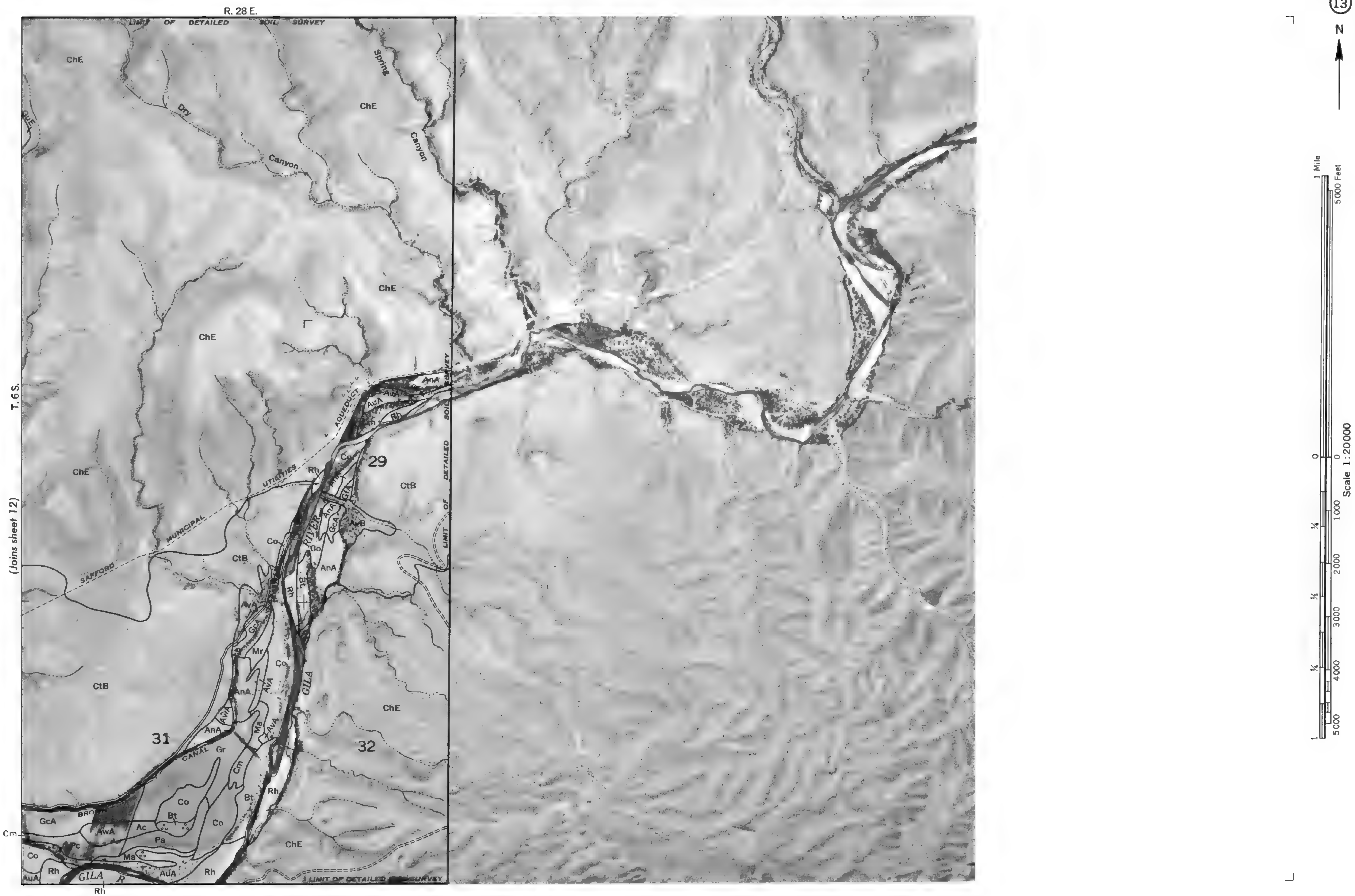

Land division corners are approximately positioned on this map.

Land division corners are approximately positioned on this map

Land division corners are approximately positioned on this map.

N

(Joins sheet 10)

R. 26 E.

1 Mile

5000 Feet

Scale 1:20000

(Joins sheet 15)

T. 7 S.

(Joins sheet 17)

(Joins sheet 21)

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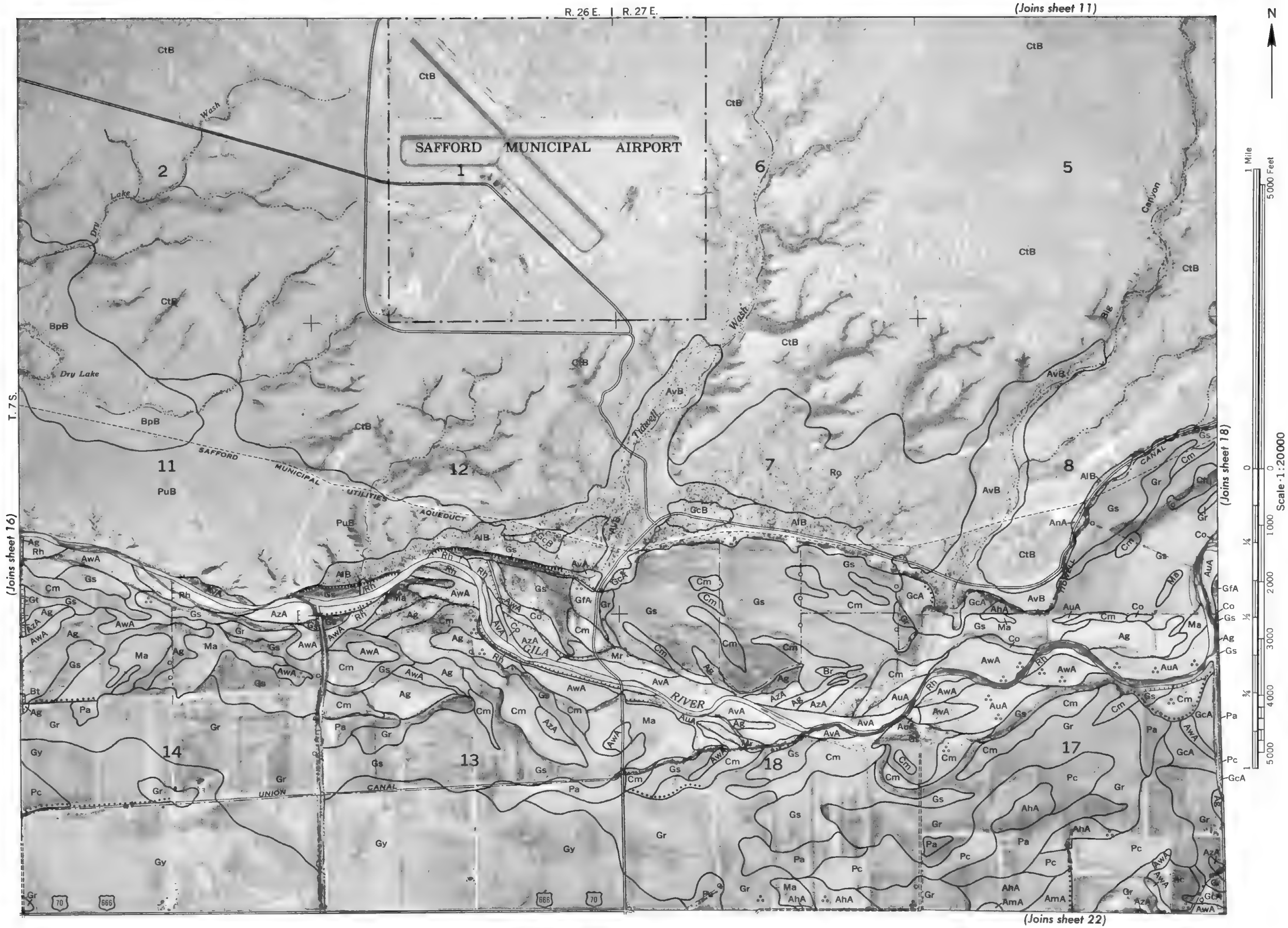

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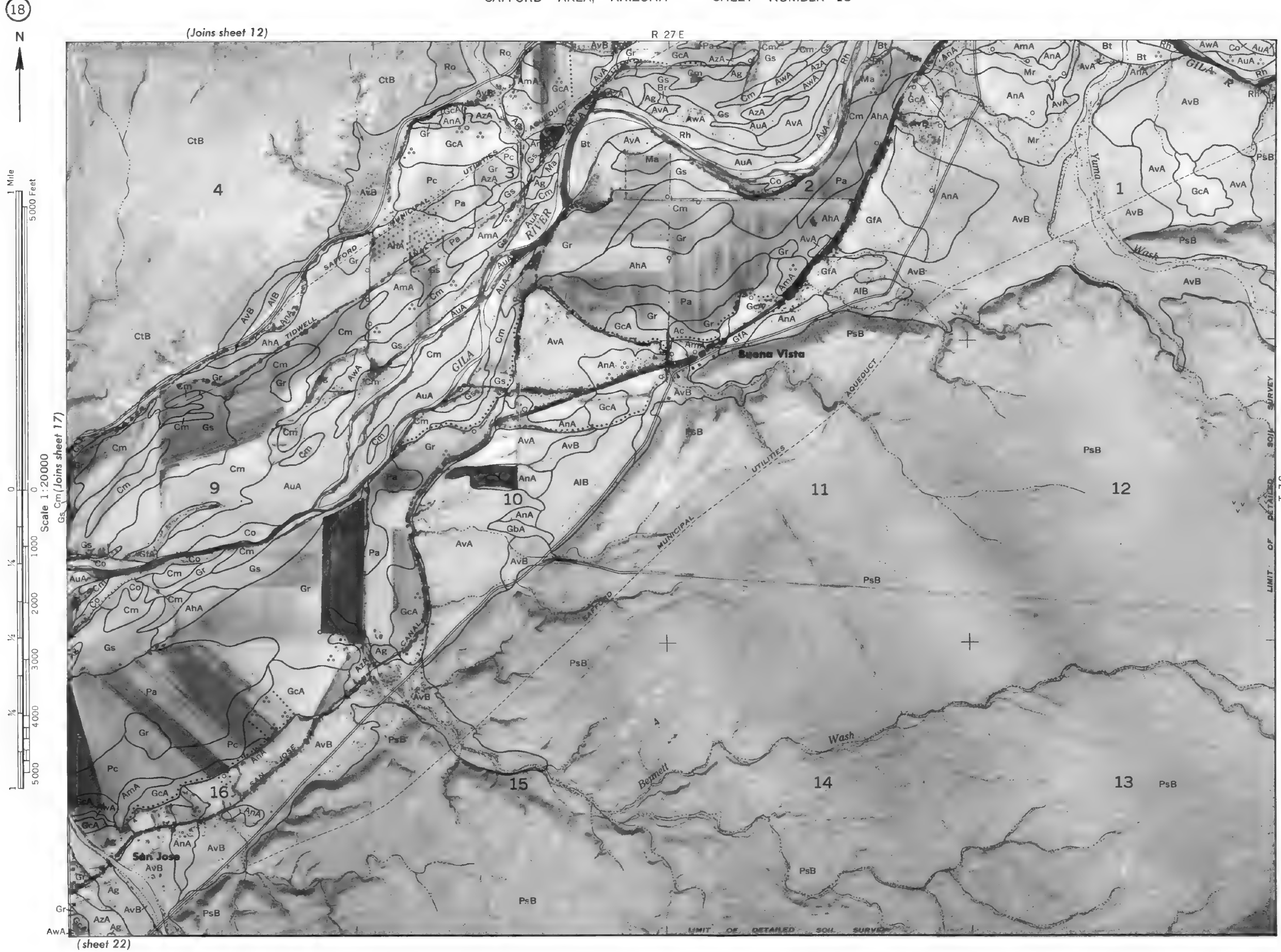
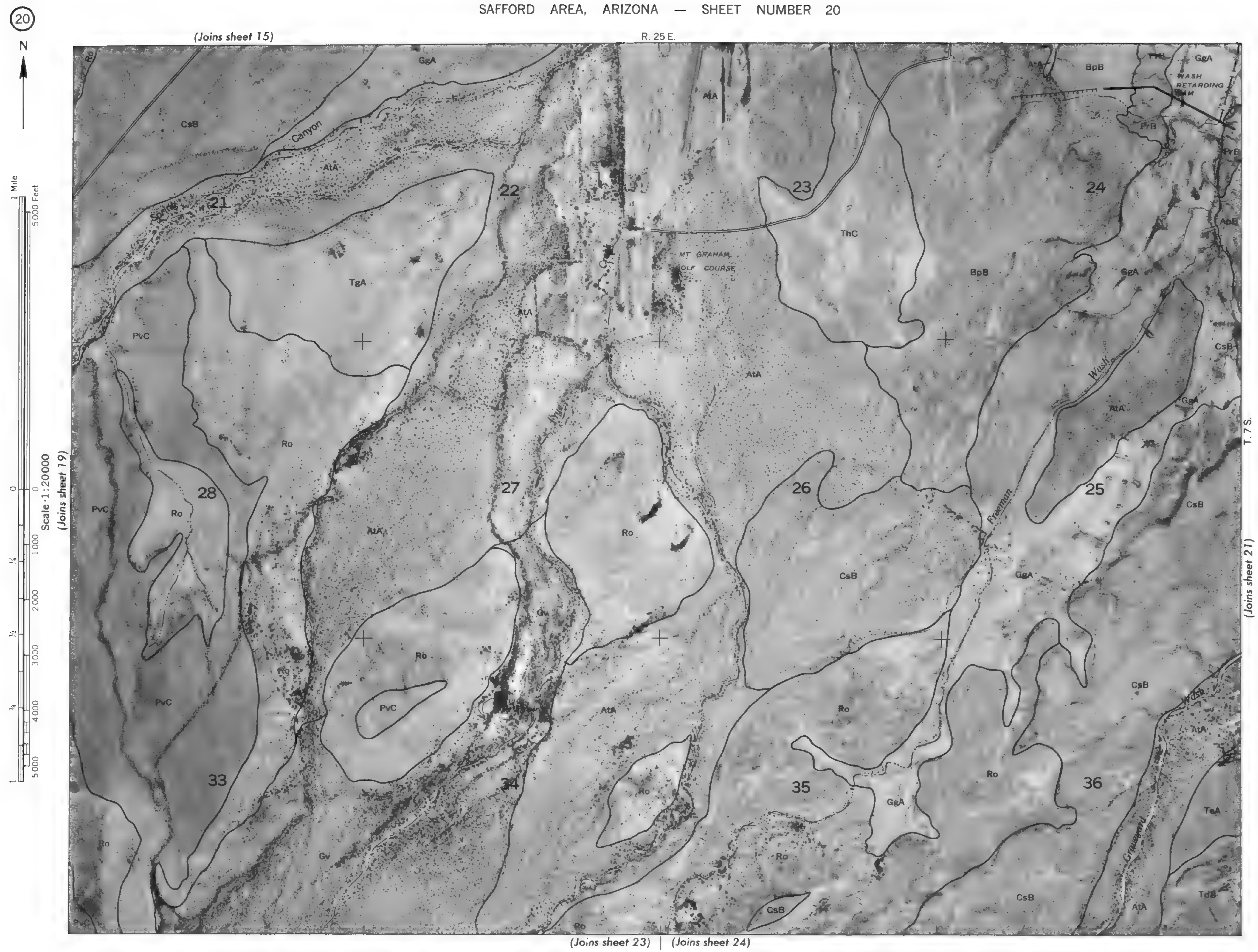


Land division corners are approximately positioned on this map.

19

Land division corners are approximately positioned on this map.



Land division corners are approximately positioned on this map

Land division corners are approximately positioned on this map.

Land division corners are approximately positioned on this map.

(Joins sheet 19)
(Joins sheet 20)
R. 25 E.
N
T. 8 S.
Land division corners are approximately positioned on this map.
(Joins sheet 24)
(Joins sheet 26)
LIMIT OF DETAILED SOIL SURVEY
CORONADO NATIONAL FOREST
Deadman Canyon
Creek
Pine
3
4
5
6
8
9
10
15
AtA
PvC
Ro
Gv
CsB
ClF
1 Mile
5000 Feet
0
¼
½
¾
1
0
1000
2000
3000
4000
5000
Scale 1:20000

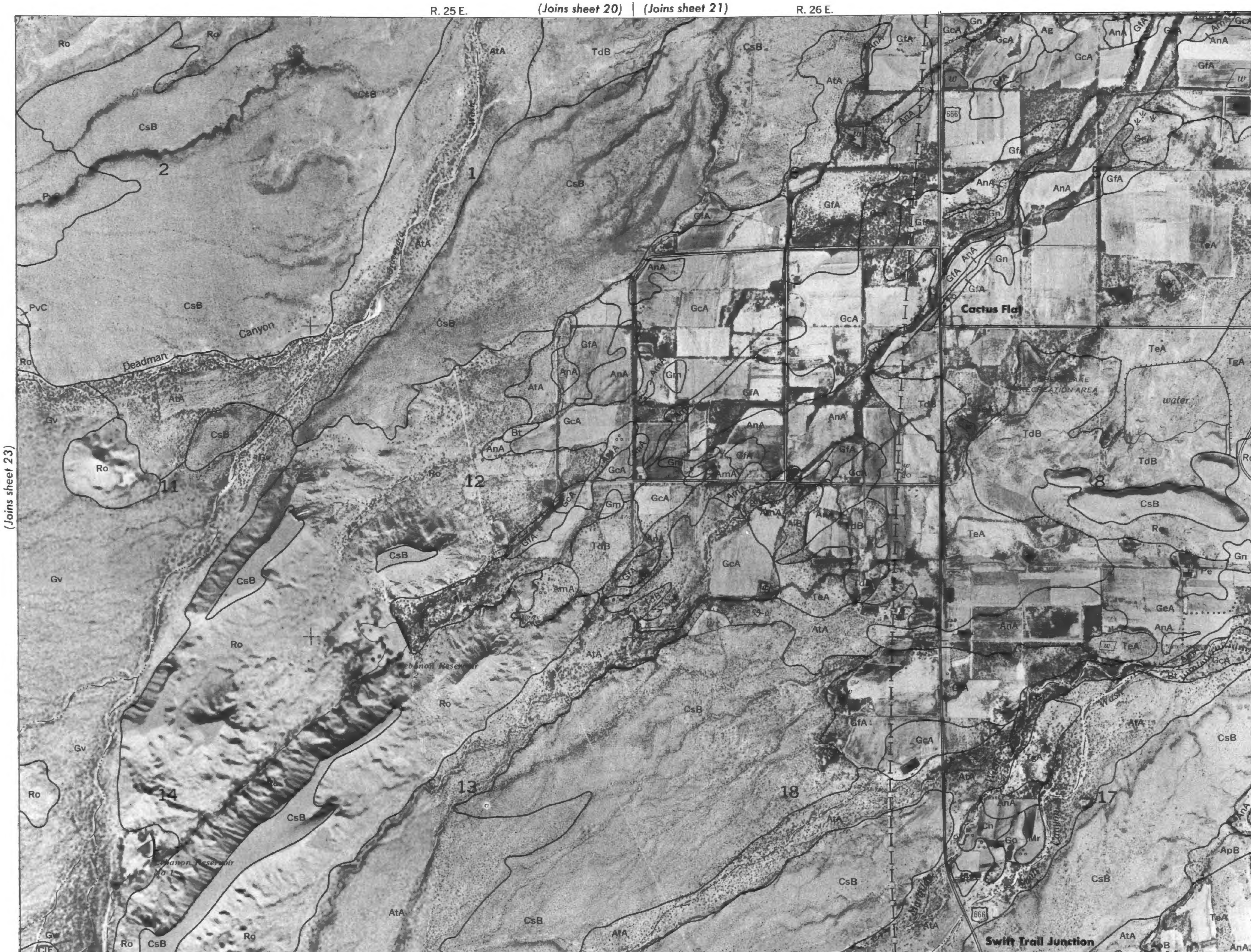
(24)

SAFFORD AREA, ARIZONA — SHEET NUMBER 24

N

(Joins sheet 20) | (Joins sheet 21)

R. 25 E. R. 26 E.



(Joins sheet 23)

(Joins sheet 25)

(Joins sheet 26)

CsB

AnA

Scale 1:20000

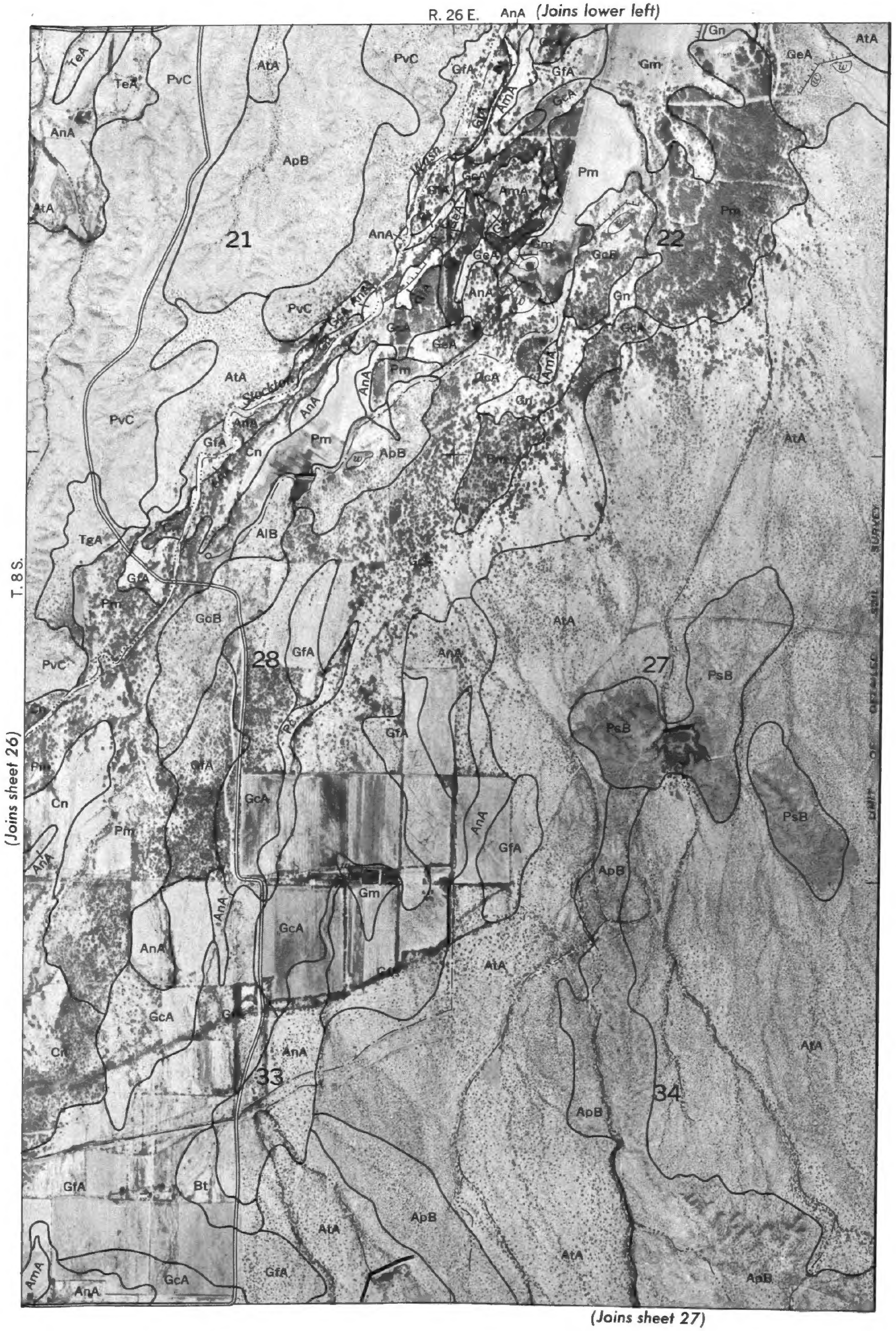
1 Mile ¾ ½ ¼ 0

5000 Feet 4000 3000 2000 1000 0

Land division corners are approximately positioned on this map.

25

Land division corners are approximately positioned on this map.



N

1 Mile · 5000 Feet

0 · ¼ · ½ · ¾ · 1

0 · 1000 · 2000 · 3000 · 4000 · 5000

Scale 1:20000

SAFFORD AREA, ARIZONA — SHEET NUMBER 26

N

(Joins sheet 23) | (Joins sheet 24)

R. 25 E. | R. 26 E.

T. 8 S.

(Joins inset, sheet 25)

(Joins sheet 27)

1 Mile 5000 Feet

0 0

1000

¼ 2000

½ 3000

¾ 4000

5000

1 5000

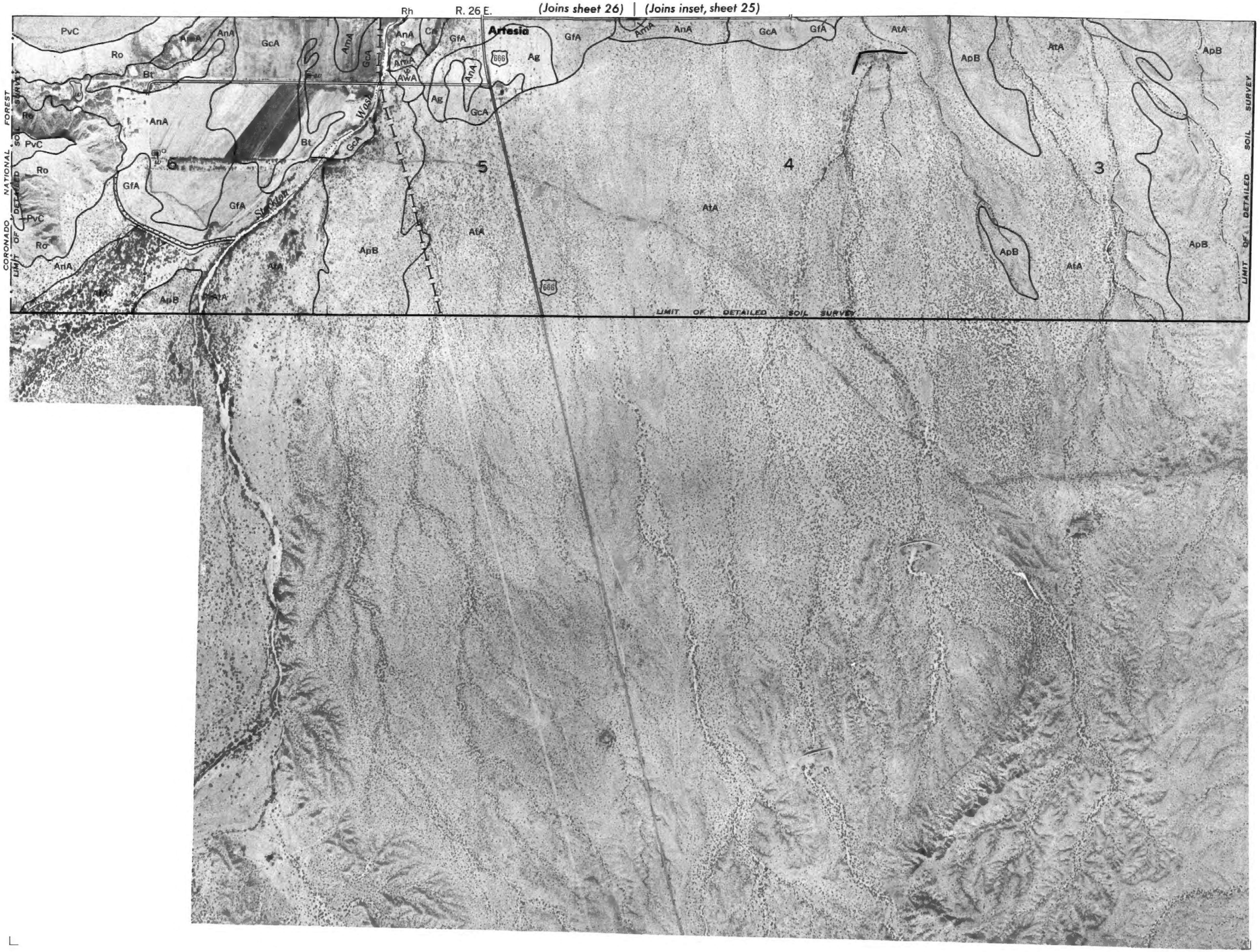
Scale 1:20000

Land division corners are approximately positioned on this map.

27

T. 9 S.

Land division corners are approximately positioned on this map.



N

1 Mile
5000 Feet
0 ¼ ½ ¾ 1
0 1000 2000 3000 4000 5000
Scale 1:20000